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US EPA Region 8
Denver, CO

Submitted by:
Atlantic Richfield Company
La Palma, CA
July 21, 2014

2014 Solids Removal Work Plan

Rico-Argentine Mine Site – Rico Tunnels
Operable Unit OU01
Rico, Colorado

Atlantic Richfield Company

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July 21, 2014

VIA EMAIL AND OVERNIGHT COURIER

Mr. Steven Way
On-Scene Coordinator
Emergency Response Program (8EPR-SA)
US EPA Region 8
1595 Wynkoop Street
Denver, CO 80202-1129

Subject: 2014 Solids Removal Work Plan Rico-Argentine Mine Site – Rico Tunnels Operable Unit OU01 Rico, Colorado

Dear Mr. Way,

A digital file in PDF format of the 2014 Solids Removal Work Plan, Rico-Argentine Mine Site – Rico Tunnels Operable Unit OU01, Rico, Colorado dated July 11, 2014, is being submitted to you today via email. Three (3) hard copies of the report will also be sent by overnight courier to your office.

Atlantic Richfield Company (AR) is submitting this report responsive to requirements in Task B – Management of Precipitation Solids in the Upper Settling Ponds / Subtask B2 – Interim Ponds Solids Management of the Remedial Action Work Plan accompanying the Unilateral Administrative Order for Removal Action, Rico-Argentine Site, Dolores County, Colorado, U.S. EPA Region 8, Docket No. CERCLA-08-2011-0005.

If you have any questions or comments, please feel free to contact me at (714) 228-6770 or via email at Anthony.Brown@bp.com.

Sincerely,

Anthony R. Brown

Tony Brown
Project Manager
Atlantic Richfield Company

Enclosure (2014 Solids Removal Work Plan)
cc: Terry Moore, Atlantic Richfield
Sandy Riese, EnSci
Chris Sanchez, AECI
Dave McCarthy, Copper Environmental
Tom Kreutz, AECOM
Doug Yadon, AECOM
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1.0 Introduction

1.1 Purpose

Anderson Engineering Company, Inc. (AECI), in cooperation with AECOM Technical Services, Inc. (AECOM) and Pioneer Technical Services, Inc. (Pioneer) on behalf of Atlantic Richfield Company (AR), has prepared this 2014 Solids Removal Work Plan (Work Plan) to describe the actions that will be implemented at the Rico-Argentine Mine Site – Rico Tunnels Operable Unit (OU01) to remove deposited materials via a combination of dredging and excavation from Pond 14, and convey them to Pond 13 within the St. Louis Ponds system. This work is responsive to Subtask B2 of Task B of the Removal Action Work Plan. A focused review of Pond 14 removal alternatives to select the optimum removal method is presented herein. A more comprehensive evaluation of alternatives previously screened is presented in the Pond 15 Solids Removal Work Plan (AR, 2012).

The UAO and EPA Schedule Modification, dated January 10, 2012, required completion of the St. Louis ponds solids removal by November 30, 2013. Per discussions with EPA (Communication, Steve Way, 2013) removal of solids from Pond 14 was deferred until 2014 (Documented in the May 2013 Preliminary Schedule). This deferral was to aid in completion of the development of demonstration-scale wetlands during 2013. During the 2013 work season, Pond 14 was examined as a possible location for a Demonstration Vertical Flow Wetland. It was determined that removal of all the deposited material contained within Pond 14 would be required for use as a demonstration vertical wetland location. Further evaluation of alternative locations and other technical considerations eliminated Pond 14 as the preferred location of the Demonstration Vertical Wetland. Following conversations with EPA the work was confirmed for completion in 2014. Per the EPA June 2013 Schedule Modification (Rico Argentine Mine Site-UAO, Docket No. CERCLA-08-2011-0005), Pond 14 solids removal is to be complete by October 31, 2014.

1.2 Solids History and Previous Removal

Solids have accumulated in the upper ponds of the St. Louis Ponds system as a result of precipitation and settling of metals by natural processes and by lime addition to the St. Louis Tunnel discharge from 1984 to 1995. Potential for release of water and flowable solids and the opportunity to increase overall detention led to the plan to remove solids from the upper ponds (see the Initial Solids Removal Plan [ISRP] dated May 2, 2011, submitted to the EPA by AR). The upper pond volumes were to be increased to provide adequate detention time and capacity for water and future accumulation of settled solids, and to reduce the potential impacts to the Dolores River in the event of an uncontrolled release of the solids contents of one or more of the upper ponds to the river. All but 2 feet of Pond 18 solids were excavated conventionally by mechanical method and placed in an interim drying facility constructed over the inactive Ponds 16/17 area in 2011. The two feet were left in place to retard the downward seepage of pond water through any calcine tailings present and into the underlying predominantly coarse-grained alluvium deposits. Ponds 15, 12, and 11 solids were dredged and conveyed to interim storage in Pond 13 during 2012 and 2013, again leaving approximately 2 feet of solids in place (for the same reason).

1.3 Pond 14 Contents Removal Investigations

In early 2001, Pond 14 coring data suggests that there are little to no calcines present in Pond 14. However, 2013 field probing surveys indicate that calcines may be present underneath the solids layer to a depth of approximately 3 feet. The latter survey also indicated that the solids layer on top of the calcines averages about 2-2.5 feet. The earlier work included only two cores and probing whereas the latter work included numerous probings and relied only on indirect indications of calcines. Several options for handling the Pond 14 materials were studied that included no action, removal of all pond materials (solids and calcines), and removal of pond materials (solids and calcines) and leaving a 2-foot seepage reduction layer. The selected option is to remove all but 2 feet of solids/calcines. Significant downward seepage is not expected in Pond 14 if the remaining seepage reduction layer is comprised primarily of calcines. The permeability of the calcines is expected to be a half order of magnitude higher than solids. Cross sections of Pond 14 solids and calcine layers from the 2013 survey are presented in Attachment 1.

1.4 Pond 18

Prior to commencing solids removal in Pond 14, the currently inactive Pond 18 will be used to temporarily store water from the St. Louis discharge that is normally routed into Pond 15. This will allow dewatering of Pond 15 to facilitate replacement of existing discharge pipes and modifications of existing diversion pipeworks on the Pond 15 south embankment. The pipe upgrades are needed to facilitate pipe connections and safe operation of the St Louis discharge water gravity flow by-pass system. Additionally a backup pump will be available to route water from Pond 18 to Pond 14 as required.

1.5 Scope

The scope of the 2014 removal project includes removal of solids and calcines as may exist from Pond 14 along with necessary pond water management to safely facilitate removal and minimize sediment release. In addition, improvements to the system to safely manage water will be constructed, including an upgrade to the Pond 15 Outlet. The Pond 14 removal involves a combination of conventional mechanical excavation and suction dredging of Pond 14 solids and possibly calcines and conveying these removed materials to storage in Pond 13 together with the previously placed Ponds 11, 12, and 15 solids.

The 2014 solids removal of Pond 14 is broken into the following work items: 1) improve and maintain the water management system within the upper St. Louis Ponds system to direct and control flows from the St. Louis Tunnel discharge during the removal operations; 2) dike improvements and water management to provide acceptable access for necessary equipment on Pond 14 dikes; 3) extraction of solids and possibly calcines from the east side of Pond 14 containing large amounts of debris by mechanical excavation; 4) extraction of solids and calcines by suction dredging from the remaining portion of Pond 14; and 5) conveyance of removed materials to Pond 13 for consolidation with previously dredged Pond 11, 12 and 15 solids.

As discussed in Section 4.3, following the removal of material from Pond 14, the total volume transferred into Pond 13 is expected to reach approximately 6,000 cubic yards (CY) (including previously placed solids from Ponds 11, 12 and 15). Improvements to Pond 13 completed in 2012 resulted in a total of approximately 10,000 CY of dredged solids storage capacity. Due to consolidation during dewatering, solids volume decreases between removal from saturated conditions in the online ponds to drained conditions in the offline Pond 13. Addition of new solids and subsequent surface drying further consolidate solids. Following placement of solids from Pond 15 in 2012 and from Pond 11 and 12 in 2013 (totaling approximately 4,100 cy), approximately 4,600 cy of available capacity remains in Pond 13 to accommodate Pond 14 removal in 2014. The design and operation of Pond 13 is described in the 2012 Pond 15 Solids Removal Work Plan and was approved by EPA on August 3, 2012. Figures showing the location of anticipated materials removal from Pond 14 and disposal in Pond 13 are presented in Attachment 1.

In preparation for the removal of Pond 14 materials, dike improvements and modifications to the existing pipeworks system used in the 2013 solids removal work will need to be performed. Clearing, grubbing, and grading of the west dike of Pond 14 will need to take place in order to allow for setup of dredging equipment. Dike surfacing and grading will be required on the east dike of Pond 14 to accommodate excavation equipment and a dredging launch pad that will need to be constructed on the Pond 14 east dike as well (see Figure 2 in Attachment 1).

During the winter following the 2013 solids removal activities, a partial detachment of the 18” to 12” HDPE pipe reducer occurred on the Pond 15 upper discharge pipe. No damage to the embankment occurred due to preplanned location and placement of the pipeline. A reconfiguration of the pipe system has been developed to facilitate a safer operation of the water management system and will be implemented as part under this work plan prior to commencement of solids removal activities.

1.6 Responsibilities

The Pond 14 solids removal and interim storage in Pond 13 will be completed under the direction of AR per approval of the EPA. AECOM will be the responsible Engineer, with AECI and Pioneer providing technical support and planning for the excavation, dredging and water management operations, as well as field oversight, management, construction quality control, and surveying. Dredge operation, excavation, pond dike improvements, and other construction activities will be provided by Flare Construction, a qualified construction contractor, under direction and oversight by AECI. These roles are summarized as follows:

- **Responsible Party –** AR
- **Design –** AECOM (Engineer) / Pioneer / AECI
- **Field Oversight/Construction Management/QC –** AECI (Field Manager)
- **Survey –** AECI
- **Construction Contractor –** Flare Construction
- **Dredge Operation Assistance –** Pioneer; AECI

2.0 Objectives

The main objective of this work is to remove solids and possibly some calcines from Pond 14 and consolidate them for interim storage within Pond 13 as part of the management of precipitated solids responsive to Subtask B2 of Task B of the Removal Action Work Plan and the approved ISRP. The components of this objective of the Pond 14 removal described in this Work Plan are to:

- Improve access to Pond 14 as necessary to facilitate the removal of materials via suction dredging and mechanical excavation.
- Improve and maintain a water management plan for the St. Louis Ponds system and the dredging operation during Pond 14 excavation and dredging operations.
- Improve the Pond 15 Outlet to facilitate the safe removal of materials.
- Remove materials from Pond 14 and transfer to Pond 13 via two methods, leaving a nominal 2 feet of solids or possibly calcines as a seepage reduction layer. This remaining layer is to limit seepage loss to the underlying predominantly coarse-grained alluvial aquifer.
- Remove debris, solids, and possibly calcines by mechanical excavation from the east side of Pond 14. This method may constitute up to approximately 25% (410 CY) of total pond material removal. Excavated material will be moved across the Pond 13/14 separation dike and placed in Pond 13 by mechanical means directly across the dike from the removal area.
- Remove remaining Pond 14 materials via suction dredge and transfer these materials via slurry line to the southeast corner of Pond 13. This method may constitute approximately 75% (1,240 CY) or more of the total removal.

The design bases and work tasks necessary to achieve these objectives are described in the following sections of this Work Plan.

3.0 Summary of Removal Alternatives

Several solids removal methods were thoroughly examined in 2011, 2012, and 2013 for solids removed from Ponds 11, 12, 15, and 18. These options included removal by suction dredge, conventional excavator, drag line, and slusher hoist. The method ultimately selected for removal from Pond 18 in 2011 was conventional excavator. For the removal of solids from Ponds 11, 12, and 15, removal via suction dredge was selected. Given the success of the dredge removal in Ponds 11, 12, and 15 and the success of conventional excavation removal in Pond 18, as well as the analogous access conditions and constraints in Pond 14 discussed below, removal by a combination of suction dredge and conventional excavation is preferred for Pond 14.

3.1 Material Removal Objectives

Removing the solids and/or calcines and leaving a seepage reduction layer in Pond 14 is the recommended alternative for the Pond 14 removal.

- This option meets the requirements of the UAO.
- The current central flow path will be eliminated and the entire pond will allow for improved water spreading and detention, and thereby improved solids settlement.
- Pond 14 solids volume capacity will be increased.
- The two-foot layer of solids and/or calcines to be left in place will reduce seepage from Pond 14 into the underlying predominantly coarse-grained alluvial aquifer.
- The combination of using conventional excavation and the barge mounted suction dredge is recommended as this approach allows each removal type to be used in the

area that maximizes its efficiency. Excavation is ideal for removing solids with large debris. The debris in Pond 14 is located along the east dike and can be reached for removal from the dike eliminating any need for new causeways. Dredging has proven to be a safe and effective method of removing solids from ponds at the Rico work site. In 2012 and 2013 dredging has been the method selected to remove solids from Ponds 15, 12, and 11. The unmanned remote-controlled dredge is ideal for removing solids without having to dewater and continually pump ponds that have groundwater levels within the depth of solids. It is recommended that a combination of excavation and dredging be used to remove solids and possibly calcines from Pond 14.

3.2 Removal via Pond Perimeter Excavation

Due to the significant amount of debris in the eastern portion of Pond 14, suction removal by dredging is not feasible for the entire pond. Mechanical excavation will be used to remove large amount of debris within the solids and possible calcine materials on the east side of Pond 14. Removal will only be conducted within the reach of a long-reach excavator positioned on the Pond 13/14 separator dike perimeter and the excavator will not enter the Pond 14 area. Thus, no dewatering will be required; however, the pond will be unwatered to facilitate removal. Mechanical excavation has proven to be a safe and time effective method to remove solids, as was seen during the 2011 Pond 18 solids removal work which included both perimeter excavation and dewatering and pond entry via causeway. Removal rates for mechanical excavation can be up to 500 – 600 CY per day, versus approximately 100 CY per day from suction dredging. The materials in Pond 14 are consistent with materials encountered in Pond 18, with the exception of a greater amount of debris in a portion of the Pond 14 solids. Due to the higher groundwater conditions in Pond 14 and the geotechnical difficulties associated with dewatering and pond entry, mechanical excavation is not the best alternative for total removal of material from Pond 14. Mechanical excavation of the entire pond while leaving 2 feet as a seepage reduction layer requires more extensive geotechnical evaluations and building of causeways in order to be successful.

A CAT 330 (or equivalent) Long Reach excavator will be used for the removal and will be positioned on the east dike of Pond 14. In 2013, this dike was improved to accommodate this type of equipment, and a geotechnical stability analysis of the Pond 14 east dike presented herein indicates that it can accommodate this equipment for the removal activities. Additionally, this location is ideal for removal, since excavated material can be placed directly into the west portion of the adjacent Pond 13, thereby avoiding double handling.

3.3 Removal via Suction Dredge

The operation of the suction dredge is by remote control with emergency cut-off capability from shore. The suction dredge operation consists of an unmanned (remote control), floating, shallow-draft barge with a rotating horizontal cutter-head to dislodge solids to feed to a slurry pump system and discharge line. This type of equipment facilitates removal of wet solids with the physical properties of viscous sludge. Barge-mounted suction dredges are capable of sludge or sediment removal in water-occupied locations, and the source areas do not require draining or drying. Suction dredge technology has been successful in removing large quantities of water-submerged materials and transporting and accommodating several methods of disposal. Use of suction dredges with cutter-heads has proved a viable method of removal of solids at settling ponds at Atlantic Richfield's Butte Treatment Lagoons (BTL) sediment removal activities in Butte, Montana as well as for Ponds 15, 12, and 11 at the Rico Site.

The suction dredge method does not require the extensive geotechnical improvements to existing dikes to access the pond that are otherwise required by large excavation equipment in order to remove solids in the interior of the pond. No pumping of pond fluids is needed, nor is a drying period for the solids prior to removal. No access causeways are required to reinforce the foundation pad for excavation equipment to enter the pond area for adequate reach to remove solids and thus no dewatering of pond solids is required. The barge-mounted dredge is not hindered by groundwater conditions, as the equipment is floated on water currently in the pond. Water safety procedures will have to be fully implemented when working with barge-mounted suction dredge equipment.

4.0 Pond 14 Removal Work

The Pond 14 removal will involve four types of work:

- **Water Management** will consist of separating the St. Louis Tunnel (SLT) discharge and flow through the pond system into a circuit separate from the Pond 14 dredging / Pond 13 settling circuit to minimize the potential for release of disturbed solids. St. Louis Tunnel discharge water will be managed to maintain detention time for settling existing tunnel effluent, and will provide makeup water used in the dredging operation if necessary. Existing pipeworks from 2013 Ponds 11 and 12 dredging will be used to route SLT discharge around Pond 14 as necessary during dredging and when makeup water is not required. The modifications of the Pond 15 outlet and other minor modifications to the system will be implemented prior to dredging.
- **Pond Access and Dike Improvements** will consist of minor grading, leveling, and surfacing in the Pond 14 area.
- **Removal of Debris and Pond Material on East Side of Pond** will consist of positioning a CAT 330 long reach (or equivalent) excavator on the east dike of Pond 14 and removing debris and solids.
- **Suction Dredge Solids Removal** will involve an unmanned suction dredge sludge removal system that will be used to collect and pump the solids and possibly calcines from Pond 14 and transfer them to Pond 13, with recirculation of decanted water back to Pond 14.

4.1 St. Louis Ponds System Water Management

The St. Louis Ponds system water management plan will control flows from the St. Louis Tunnel discharge to regulate flows through and maintain adequate detention time within the existing ponds network during Pond 14 removal activities. As part of the plan, the system will be separated into two circuits: a circuit to continue managing St. Louis Tunnel discharge, and a circuit to manage the dredging/settling. Existing pipeworks from the 2013 Ponds 11 and 12 solids removal work will be utilized during the Pond 14 solids removal, with only minor modifications needed.

4.1.1 Pond 15 Outlet Modifications

One particular modification will be to the 18” to 12” HDPE reducer fitting on the Pond 15 upper pipe discharge. This pipe fitting experienced a slight separation from the existing mild steel pipe during the winter of 2013 / 2014. Only minor erosion occurred in the area of the fitting and no damage to the embankment occurred due to preplanned location and placement of the pipeline. To solve this issue the 12” line to Ponds 9, 11 and 12 will be run through the dike to Pond 15 to provide a non-detachable continuous pipe with a head gate for upstream flow control. Eliminating the reducer and providing "Beaver Deceiver" chain link fencing will also reduce the possibility of clogging with debris. A second 18” HDPE overflow pipe with entrance head gate and no downstream gate that could act as an obstruction will be installed to route flow from Pond 15 to Pond 14. As described in the next section, the new outlet will be lowered 6 inches to improve the stability and freeboard of Pond 15. All modifications to the Pond 15 outlet pipes will be performed in accordance with the Construction Technical Specification attached to the end of this document.

This work will be conducted at the beginning of the project to provide bypass capability of Pond 15 outflows. The modifications require that Pond 15 be lowered and maintained a minimum of two feet below current elevation to allow for pipe excavation and replacement. Just prior to the start of this work, water will be routed to Pond 18, which is currently offline, and Pond 15 will be simultaneously dewatered to the level of solids utilizing a pump that will pump water from Pond 15 to Pond 14 at the southwest corner of Pond 15. This will provide a window to complete the Pond 15 modifications while Pond 18 is filling and capturing adit inflow. The modifications are expected to take a day, whereas the filling of Pond 18 is expected to take several days. Should the modifications unexpectedly take longer than it takes Pond 18 to fill, the pump will be utilized to keep Pond 15 dewatered.

Stability analyses are provided in Attachment 2 for the case of a CAT 330 equivalent backhoe on timber mats performing the modifications on the Pond 15 South Dike. Factors of Safety exceed minimum criteria of 1.3.

4.1.2 Pond 15 Stability

Removal of solids in Pond 14 adjacent to the toe of the Pond 15 South Dike will reduce the buttress effect on the toe. A stability analysis of the Pond 15 South Dike indicates it is currently at a Factor of Safety of 1.3, less than required for long-term stability (1.5) but matching minimum criteria for temporary construction (1.3). Upgrades to the dike are anticipated in future work, and in order to keep the Factor of Safety at or above 1.3 for temporary construction, it is necessary to leave 20 feet of material as a buttress against the toe of the Pond 15 dike. The bulk of this material is not solids or calcines based on surface observation and the results of materials investigations described in Section 1.3 and thus would not normally be removed as part of this work. In addition, the outlet modifications described in the previous section will result in the lowering of the pond by 6 inches to improve stability and freeboard. Finite element seepage analyses and stability runs of a critical section on the west side of the dike are included in Attachment 2.

4.1.3 Key Elements

Key elements of the water management plan are shown on figures included in the appendix to the Technical Memo in Attachment 2. The water management plan will consist of the following elements:

- **Upper Ponds Water Management (Ponds 15 and 18) –** St. Louis Tunnel discharge water will normally be directed to Pond 15 during the removal operations. St. Louis Tunnel discharge will temporarily be routed into Pond 18 while modifications to the Pond 15 discharge pipe are being performed. The removal of solids in 2011 and 2012 from Ponds 18 and 15 respectively, expanded the capacities of those ponds. Routing the water through Ponds 15 will aid in maintaining detention time for the tunnel discharge water during the Pond 14 removal operations.

- **System Inflow Isolation – Ponds 11, 12, and14 Bypass and Back-up System –** Because the discharge from the upper ponds may at times exceed the need for water in the dredging circuit, a 12-inch gravity feed HDPE pipeline was installed in 2013 from Pond 15 to Pond 9. This pipeline will be used to route water around Pond 14 to isolate it from the ponds settling circuit during dredging operations. The pipeline has the capability to intercept flow at the Pond 15 outlet and route the flow to either Pond 14, 12, 11 or 9. The gravity feed pipeline has the capacity for a flow of approximately 1,300 gpm, which addresses the estimated seasonal peak St. Louis Tunnel discharge quantity and the flow resulting from a 25-year/24-hour storm within the ponds area. Any flow in excess of a 25-year/24-hour storm will be passed through the pond overflow spillways. A separate back-up pipeline will be fitted with a supplemental back-up pump and used as needed. The back-up pump will remain offline unless required to lower Pond 15 water elevation, increase flow into Pond 14, and relieve stormwater or added tunnel discharge. The pump capacity will be up to 1,500 gpm to accommodate quick lowering and raising of ponds, tunnel discharge flow, and direct rainfall into the ponds. The back-up pipeline will have the capability to pump from Pond 15 and distribute water to Pond 14 or to Pond 9. Pumping down Pond 15 will raise the Geotechnical Safety Factor of the Pond 15 south dike. The higher Safety Factor will allow for much needed excavator access and increased safety during dredging operations. The back-up pipeline will also be used to increase the flow into Pond 14 during dredging operations when direct tunnel discharge and recirculation flows are insufficient to maintain desired water elevation in Pond 14.

- **Circuit Outflow Isolation –** Pond 14 will be unwatered (by diverting inflow) for mechanical excavation to eliminate disturbed particulates from migrating downstream. The existing Pond 14 outlet is uncontrolled; during dredge removal the outlet will be controlled by sandbag or earthen cofferdams supported by silt fence to minimize solids outflow as feasible and necessary and to temporarily raise the water elevation of Pond 14 by one foot. The water level in Pond 14 will be raised during dredge removal for a number of reasons. The dredge requires 18” of water to float the dredge and the water depth of the pond is less than 6” in some locations. Raising the water level also increases the Geotechnical Safety Factor of the Pond 15 south dike. Recent flows from the St. Louis Tunnel have been less than the pumping rate of the dredge while in operation. This creates a negative balance for the water in Pond 14. By temporarily regulating the outlet, the amount of time that the dredge can run in a day is increased. Additionally, the outlet control minimizes the chance of solids disturbed by the dredge from escaping the dredging circuit through the Pond 14 outlet to the lower ponds. Pond 14 will also receive the recirculation water from Pond 13 once the dredged precipitates have settled out and adequate water volume is present to begin recirculation. A balance between water level necessary for dredging and water level needed to minimize flow out of Pond 14 will be managed during operations.

- **Dredging Circuit Outflow Isolation – Pond 13 Recirculation –** Recirculation of decanted water from Pond 13 back to Pond 14 will be used to maintain dredging operations as well as prevent overflow of Pond 13 decant water to the lower ponds. The decanted water will be pumped back into Pond 14 to recirculate the water utilized by dredging and keep disturbed solids in the closed circuit. Pond 13 Normal High Water Level (NHWL) of 8807.50' will be maintained via the recirculation pump system. This elevation provides greater than 2.0 feet of freeboard on the Pond 13 dikes and 1.0 foot of freeboard to an emergency overflow established at elevation 8808.50' between Pond 13 and Pond 10. When recirculation begins, and should no additional flow be needed into Pond 14 to float the dredge, the St. Louis Tunnel discharge water will be directed into Pond 15 and/or 18, and the water from Pond 15 will be diverted to Pond 12 to bypass flow into Pond 14.
- **Pond 13 Settling of Slurry Materials -** Based on settlement calculations (attached) it is estimated that more than 80 percent of the solids in the slurry are expected to settle out in Pond 13 at maximum production rate. The calculations are based on the grain size of Pond 15 solids. A portion of Ponds 14 solids may be finer, and thus solids removal efficiencies may be reduced during dredging of these materials. Actual settling will be monitored closely and will depend on actual production rates as well as the characteristics of the solids themselves. Removal of Pond 15 solids in 2012 via dredging resulted in very high settlement rates (over 90%). Should solids be much finer than anticipated, the schedule can accommodate slower production rates to settle solids, or a flocculent selected for Pond 15 removal in 2012 can be added. Since the dredge/recirculation circuit is essentially closed, it is not expected that the suspended solids will escape the circuit as long as design storms are not exceeded.
- **Dredging Circuit Supplemental Supply Water –** To provide water for dredging and pumping operations and to float the dredge barge, Pond 15 outflow water will be directed to Pond 14. Once the decanted water from the recirculation line from Pond 13 provides sufficient water to Pond 14 to maintain the desired water elevation, Pond 15 outflow will be directed to Pond 12. When both Pond 15 outflow and the recirculation line cannot provide adequate flow to maintain the desired water elevation in Pond 14 the back-up system will be deployed to increase the inflow into the dredging circuit. The management of these three systems will be implemented to maintain the required water elevation to safely operate the dredge.
- **Stormwater Diversion –** The existing stormwater diversion system will be maintained for use during Pond 14 removal activities. The diversion channel was design to route run-on from a 25-year/24-hour return period storm event for the interim drying cell area and Pond 18 removal in 2011. This diversion channel was expanded during the 2012 solids removal and will serve to control run-on into Ponds 11, 12, 13, 14, 15, and 18 during these work activities. In addition, the capacity of Pond 13 between NHWL and emergency overflow is sufficient to capture in excess of the 25-year/24-hour stormwater event within Pond 13. In the event that Pond 13 receives a significant storm event, discharges through the emergency overflow of Pond 13 will flow by gravity into Pond 10. Pond 10 will be used in this scenario to supplement storage of water and as a potential interim water handling / supplemental detention pond. During the construction of the Solids Repository the run-on to Pond 14 will be controlled by practices implemented for this upgradient construction.

4.2 Pond Access and Dike Improvements

4.2.1 Pond 14 Dredge Access

An access pad is required to allow an excavator or crane to lower and lift the dredge and barge into and from Pond 14. The pad will be constructed at the southeast corner of the pond, as shown on Figure 2 in Attachment 1. Pad construction will consist of minor grading, leveling, compacting, and gravel surfacing as necessary. Slope stability has been verified for a launch configuration utilizing a Caterpillar 330 class excavator staged at the edge of the constructed pads to pick and set the FLUMP dredge into the ponds. The configuration, geotechnical parameters, and results of the stability analyses are provided in Attachment 2. The factors of safety (FS) in all cases analyzed (with the use of timber mats or other load distribution) exceed minimum criteria of 1.3 and are adequate for safe launch. These analyses also accommodate the combined load of the medium-duty truck (GVWR 15,000 pounds or less) planned to haul the FLUMP dredge and trailer because this load is substantially less than the excavator and will pose no stability concerns during launch and removal.

4.2.2 Pond 14 Mechanical Excavation Access

Pond 14 mechanical excavation will be completed with a Caterpillar 330 Long Reach class excavator. The excavator will be positioned along the Pond 14 east dike, moving north and south until the required materials have been removed from Pond 14. Work areas are to be accessed by site existing roads and along embankment (including dike) roads as shown on the figures in Attachment 1. Geotechnical stability analyses of the east side of Pond 14, utilizing loading equivalent to a Caterpillar 330 class excavator (the equipment suggested to implement embankment work), indicate). Geotechnical stability analyses for access of equipment to the flood dike on the west side of Pond 14 were completed for the Interim Flood Dike Upgrades project completed June 2012 and for the 2013 Solids Removal Project. These analyses indicated weight distribution timber mats will be required for excavation equipment on the dike when any lifting, material removal, or work of any nature is being performed. The figures in Attachment 1 define routes that are designated for site access. Any mobilization of equipment on any of the dikes will require a spotter to assist the operator in safely navigating its route and watching for geotechnical concerns. All access roads, including roads along the dikes, will be maintained and repaired as needed as part of the dike work. Prior to starting work that requires ground disturbance, a utility locate is to be completed on the site by use of Colorado “One Call/Blue Stake” and a second private locator for on-site private utilities.

4.2.3 Dike Maintenance

The St Louis Pond dikes related to pond access and pond system water management will be maintained and improved as needed to facilitate the work. Dike erosion control features shall also be monitored and maintained. Access roads along the dike crests will be graveled as needed and erosion control rip-rap placed in areas that may require supplemental erosion protection.

4.3 Removal Quantity

It is estimated that a total of 2,875 cubic yards of solids and/or calcines are present in Pond 14 (based on 2013 sub-bottom profiling surveys). A nominal undisturbed 2-foot continuous layer of solids and / or possibly calcines will be left to reduce the downward seepage of pond water into the underlying predominantly coarse-grained alluvium deposits. No material whether it be solids, calcines or clean fill will be removed from within 20 feet of the Pond 15 South dike. As discussed later, this material must be left in place to ensure the buttress of the dike is not disturbed, but rather is left intact for geotechnical stability. Accounting for these materials left in-place, approximately 1,650 CY of combined solids and/or calcines will be removed during the entire project.

Approximately 25% (410 CY) of the total removal volume will be removed by mechanical excavation from the eastern edge of Pond 14 (within approximately 30 feet from eastern bank). Removal by excavation will occur before dredging takes place. After removal by mechanical excavation, the western 75% (1,240 CY) of the pond will be dredged.

Existing and incoming solids in Pond 13 are expected to consolidate upon being allowed to drain, resulting in a net reduction in solids volume due to consolidation. Previous experience has demonstrated that undisturbed and previously undrained similar solids can experience primary consolidation of up to 50 percent reduction in volume; however, actual consolidation is expected to be substantially less in this instance due to shallow groundwater underlying Pond 13 impeding free drainage from the solids and possible pre-consolidation of Pond 14 in the past. Any large debris removed from Pond 14 will not be placed in Pond 13, but will be removed and set aside for disposal. Calcines that may be encountered and deposited in Pond 13 are not expected to consolidate significantly from their in place density in Pond 14.

4.4 Mechanical Solids Excavation and Debris Removal

4.4.1 Operation of the Excavator

A CAT 330 class long reach excavator (or equivalent) will be used for the mechanical excavation portion of the work. The excavator will be positioned on the east dike of Pond 14, and will move to the north and south as needed to accommodate removal. The east dike of Pond 14 was examined for geotechnical stability for this equipment and the weight reach and it was determined that the dike can safely accommodate this activity so long as timber mats are used. As solids and/or calcines are removed, the excavator will rotate each load 180 degrees and deposit the material directly into the western portion of Pond 13.

Geotechnical analyses of the south dike of Pond 15 indicates that when an excavator is used for modifying the bypass pipeline and for longer term stability, measures must be taken to raise factors of safety to acceptable limits. For this reason, 20 feet of solids adjacent to the Pond 15 dike will be left undisturbed to act as a toe buttress. Additionally, during work on the Pond 15 outlet, Pond 15 will be lowered a minimum of two feet and Pond 14 will be kept online to maximize stability. Stability analyses are included in Attachment 2.

After the Pond 15 outlet modifications are complete, water will be routed around Pond 14 to Pond 12. Unwatering Pond 14 will minimize disturbed solids or possible calcines from migrating downstream and will make the solids more static for excavation. The alluvial bottom was surveyed in 2013 and will be used to maintain the 2-foot nominal seepage reduction layer where materials are excavated. With the water diverted around Pond 14 the operator will have a clear visual of how deep of an excavation is being made and will know how deep the excavation can go in order to leave 2 feet of material on the pond floor.

4.5 Suction Dredge Solids Removal

4.5.1 Operation of the Dredge

An unmanned (remote controlled) barge-mounted suction dredge with an agitation cutting head is planned for the solids removal. The dredge system is manufactured by SRS Crisafulli. A traverse system to maneuver and guide the dredge will be constructed spanning Ponds 14in the east-west direction to allow anchoring of the system on the accessible north-south dikes on either side of the pond. The traverse system will consist of cables complying with manufacturer's requirements for anchoring and weights of the equipment. The traverse system will enable the dredge to move in an east-west direction across the pond. The J-Series Severe Duty FLUMP, which weighs approximately 4,500 pounds, will be off-loaded by a crane or loader/excavator rated for a minimum of 6,000 pounds. Per manufacturer's recommendations, four lifting slings of equal length, at least 12 feet in length, will be attached to the four FLUMP lifting eyes (provided) with a clevis at each eye. Each of the four lifting slings is attached to the lifting ring of the crane or the hoist. The FLUMP will be raised and positioned over a suitable launch site with at least 18 inches of freestanding water to float the dredge barge. The FLUMP will then be lowered into the water and temporarily beached and secured to the shore using the traverse systems anchor blocks to tie off to.

Once in the pond, the dredge will be operated remotely from the shore using a control panel, a remote and traverse system. The FLUMP dredge consists of a 50-horsepower electric motor to drive the pump and cutter-head. The motor is powered by a 125 kV generator located on the pond bank. Approximately 280 feet of floating discharge line will feed the slurry to the on-shore slurry pipeline. The FLUMP's 7.5-foot horizontal rotating cutter-head will be lowered 6 to 12 inches into the solids while the dredge advances at approximately 3 feet/minute. The dredge will traverse the same path along the cable system in a lane fashion, using several passes to remove progressively deeper solids, leaving 2 feet of undisturbed solids or possible calcines lining the pond behind. The dredge operator must pay special attention to the pond water level, pond contour map, and visual indicators to ensure that 2 feet of material are left undisturbed to line the pond. The dredge will then be moved sideways approximately 6 feet to the next lane, and the operation is repeated over the entire area of the pond. The cutter-head only operates during forward movement. The pumping rate should be maintained to prevent solids from clogging the discharge hose at a minimum of approximately 500 gpm. At the end of each day, water will be pumped through the slurry pipeline of the dredge to ensure that the slurry does not settle or create any blockages within the slurry pipeline.

The resulting slurry from the dredge will be pumped through the slurry pipeline into the southwest corner of Pond 13. Once Pond 13 begins to fill, the decanted water will be recirculated back to Pond 14. The recirculation intake will be located in the southeast corner of Pond 13. During the dredging operations, the water/slurry level in Pond 13 will be continuously monitored, and pumping will be initiated before the level reaches 8808.50'. This elevation represents the invert of the discharge pipes. If necessary to prevent solids from forming too high of a beach at the distribution point, the discharge point may be shifted to the northwest as dredging progresses.

Additionally, the Pond 14 water level will need to be raised each day to a minimum elevation of 8809.20' (one foot above the normal water elevation of 8808.20) by use of a coffer dam to be placed at the Pond 14 discharge. A staff gage will be installed near the sandbag dam to monitor water levels.

4.5.2 Water Safety

The dredge work will be completed in compliance with the BP Guidance on Practice for Design and Construction Activities Adjacent to or in Water Bodies in Conduct of Remediation of Onshore Decommissioning Activities and applicable Marine Safety requirements. A Marine Assurance Plan prepared for the 2013 Ponds 11 and 12 solids removal work has been updated that includes the water work scope, location, and conditions, marine experts, vessels, inspection, operators, and vessel safety. A Water Work and Vessel Emergency Response and Contingency Plan will also be incorporated with the Marine Assurance Plan. All employees working with the dredge operation will be trained and competent regarding the use of the equipment and the water safety plans.

4.5.3 Floating Pipe and Other Pipe Works

Up to 280 lineal feet (depending on where the floating pipe connects to the on-shore pipeline) of 6 inch floating pipe and power-insulated conductor cable will be required for the FLUMP to operate over the entire area of Pond 14. Approximately 250 feet (depending on where the floating pipe connects to the on-shore pipeline) of onshore 6-inch HDPE, PVC, or aluminum pipe will continue the discharge line to the southwest corner of Pond 13.

4.5.4 Recirculation System

A centrifugal pump will recirculate decant water back from Pond 13 into Pond 14 at approximately the same rate as the slurry is being placed into Pond 13 (500 to 900 gpm) once a stable pond elevation is reached. Approximately 480 feet of 6 inch HDPE recirculation pipe will be routed from the southeast corner of Pond 13 to the southeast corner of Pond 14 secured along a bench cut below the upstream edge of the Pond 13 dike crest.

4.5.5 St. Louis Flow to Ponds 11, 12, and 14 Bypass and Back-up System

A 12-inch gravity feed HDPE pipeline is installed from the outlet of Pond 15 to the inlet of Pond 9 to bypass the dredging operation being conducted in Pond 14. This pipeline has the capability route water around Ponds 11, 12, and 14 to isolate them from the ponds settling circuit during dredging operations. The gravity feed pipeline will flow approximately 1,300 gpm at capacity, which addresses the estimated seasonal peak St. Louis Tunnel discharge quantity and the flow resulting from a 25-year/24-hour storm within the ponds area. Any flow in excess of a 25-year/24-hour storm will be passed through the Pond 15 overflow spillway to Pond 13.

A separate back-up pipeline will be fitted with a supplemental back-up pump and used as needed; however, the back-up pump will remain offline unless required to lower Pond 15 water elevation, increase flow into Pond 14, or relieve stormwater or added tunnel discharge. The pump capacity will be up to 1,500 gpm to accommodate quick lowering and raising of ponds, tunnel discharge flow, and direct rainfall into the ponds. The back-up pipeline will have the capability to pump from Pond 15 and distribute water to Pond 14. The diversion plan in Attachment 1 defines the bypass pipeline network.

4.5.6 Equipment

The dredging and mechanical excavation operations will require specific equipment to access the site safely and effectively complete the work. SRS Crisafulli (dredge manufacturer) recommends the 4-inch severe duty FLUMP suction dredge with cutter-head for removal of the solids contained in Pond 14. A 330 Class long reach excavator (or equivalent) is recommended for the mechanical excavation and will be obtained on a rental basis from the selected contractor. The dredging equipment will be obtained on a rental basis from SRS Crisafulli and will include:

- 4-inch FLUMP severe duty suction dredge system
- ~280 LF of 6-inch floating discharge line
- Cable traverse system for controlling FLUMP
- SRS Crisafulli representative on-site for FLUMP mobilization, equipment set-up, and operator training for approximately two days
- 125 KVA generator to power FLUMP
- Trackhoe excavator or extending crane and four each 12-foot slings to place the FLUMP into and remove dredge from the pond
- Eight concrete blocks to anchor cable traverse system
- Pump (750 gpm) to recirculate water to Pond 14
- ~480 LF of 6-inch pipe to recirculate decant water to Pond 14
- ~250 LF of 6-inch pipe for onshore slurry discharge line
- Pump (1,500 gpm) to transport water from Pond 15 to Pond 14 or 9
- ~720 LF of pipe to pump water from Pond 15 to Pond 9
- Approved boat and rescue skiff for service and water safety requirements

Support shall consist of the following:

- Inspect and ensure stability and safety (including signage) of access roads to the Pond 14 removal site and interim storage area within Pond 13.
- Delineate the work areas and controlled area required for the project.
- Procure, deliver, and stage required equipment, tools, materials, and supplies as approved by AECI prior to mobilization. All equipment and materials shall be in good and safe working order and suited for the work to be completed (i.e., tracked excavator and/or extended boom reach excavator, loader, and compactor). A staging area is to be established east of Pond 13 in the existing fenced facility.
- Dredge inspection, initial assembly, rotation testing and training will be completed by a competent person provided by the manufacturer prior to launching the dredge. All electrical connections, inspection, and equipment testing will be performed in accordance with the established Lockout/Tagout procedures. Dredge installation and operation will be completed in accordance with manufacturer's instructions.
- Demobilization from the site will include all equipment, tools, supplies, and unused materials. All trash and debris will be removed for legal disposal and the work site left in a clean and orderly fashion.

5.0 Site Security and Safety

The St. Louis Ponds system work areas will be secured to control access by the public and unauthorized visitors. The work areas are currently fenced with 4-feet-high steel "T" fence posts with two strands of non-barbed wire marked with colored markers along the eastern boundary. Access along the flood dike on the west area of the work area will be controlled by a locked access gate. Warning signs are posted along the fence and at gates. The gates will be opened for equipment and vehicle access to the work area and then closed during off hours.

Safety concerns identified during preparation of this Work Plan include weather, uneven terrain, water hazards, and hazardous energy. Required personal protective equipment (PPE) will include work gloves, latex sampling gloves, hardhats, safety glasses, and steel-toed boots. The work will be conducted consistent with the Rico Health and Safety Program Plan and the AECI Site Specific Health and Safety Plan. To minimize the potential for harm to personnel, equipment, or the environment, the work will be reviewed, and the appropriate Control of Work (CoW) items such as Project and Job Level Work Risk Assessments (WRAs), Daily Toolbox Meeting Records, Task Safety Environmental Assessments (TSEAs), and permits, if any (or comparable HITRA forms), will be completed, signed, and countersigned by competent personnel, as appropriate, prior to initiating any tasks associated with this work.

Any operations to be performed within 6 feet of water greater than 3 feet in depth or that has a soft bottom of sufficient thickness to become an entrapment hazard that can pose a danger of drowning must comply with BP Guidance on Practice for Design and Construction Activities Adjacent to or In Water Bodies in Conduct of Remediation or On-shore Decommissioning Activities dated June 28, 2007. A Marine Assurance Plan and Emergency Response and Contingency Plan for Vessel and Water Safety will be prepared. Personal fall protection and flotation devices (e.g., Coast Guard approved Personal Floatation Device [PFDs] vests or Type IV PFDs such as approved ring life buoys, life rings, or throwing rings equipped with at least 90 feet of retrieval line) will be used. Operations requiring the use of an approved flat-bottom boat will also require a mandatory rescue skiff. A trained and competent skiff operator will remain in the immediate vicinity of the rescue skiff at all times while personnel are working on the water.

No work shall be performed on the dredge while it is in open water. Minor tasks to be performed (i.e. engaging a breaker, reattaching a hose, cleaning of the cutterhead, and attaching lifting slings for removal and repairs) on the dredge may be performed with the dredge securely beached. The dredge must be beached with about 25% of the pontoon surface on firm soil, the barge securely moored from 2 directions and anchored on the embankment, and the cutterhead lowered onto the ground. Personnel must walk only on the pontoons while maintaining 3 point contact with one hand holding onto the dredge. If there is any indication that the pontoons are taking on water, work shall stop and a replacement unit shall be procured. For any other larger repairs, the dredge shall be removed from the water completely and placed on the east bank of Pond 14 for out-of-water maintenance.

Daily inspections of the major components of the dredging system shall be performed daily prior to commencing work. The traverse cable system in its entirety is to be inspected each day. Items to be inspected will be the anchor blocks (checking for displacement), connections, cables, clevis shackles, clamps, and barge cable winch. Generators shall be inspected daily for any damage to internal components, as well as fuel and other fluid levels. Spill containments basins underneath generators are to be inspected for potential generator fluid leaks. General work area inspections, including all component connections, are to be performed to identify any further hazards.

To mitigate electrical hazards from equipment, generators will be grounded to grounding rods properly installed adjacent to each generator. Lightning hazards are present on site, with the potential for a lightning strike to contact the dredge or the pond, routing electricity through the traverse cable system. As such, grounding rods will be installed at the anchor blocks to ground the cable system. Additionally, online resources for tracking lightning strikes will be monitored when potential for lightning strikes exists, and lightning monitors will be used by field personnel.

6.0 As-Constructed Drawings and Construction Documentation

Bathymetric (or probe) surveys will be performed post-removal to document the removal of solids from Pond 14. Pre-removal bathymetric surveys were conducted in 2013. Post-removal surveys will also be conducted on Ponds 11 and 12 to complete last year's removal efforts. In addition, the surface of solids deposited in Pond 13 will be LIDAR surveyed prior to and upon completion of removal and dewatering. Any additional characterization sampling or geotechnical sampling that may be needed will be collected post-removal.

All quality control testing required in the specifications will be obtained and reviewed for compliance with technical requirements for each construction component. Ongoing field construction inspections will be documented by written report and photographic documentation at all phases of the construction and will be assembled in the final construction documentation file.

7.0 Schedule

The Pond 14 Solids Removal will be completed on the schedule defined below. This schedule is subject to change based on actual field implementation time, weather and other ether unforeseen delays.

- **Materials and Contractor Procurement:** 6/30/2014 to 7/25/2014
- **Mobilization:** 8/4/2014 to 8/8/2014
- **Work Site Preparation, Stormwater Controls:** 8/4/2014 to 8/15/2014
- **Dike Improvements:** 8/11/2014 to 8/15/2014
- **Water Management:** 8/11/2014 to 9/30/2014
- **Excavation:** 8/18/2014 to 8/22/2014
- **Dredging:** 8/25/2014 to 9/26/2014
- **Demobilization:** 9/29/2014 to 10/3/2014

ATTACHMENT 1

Figures

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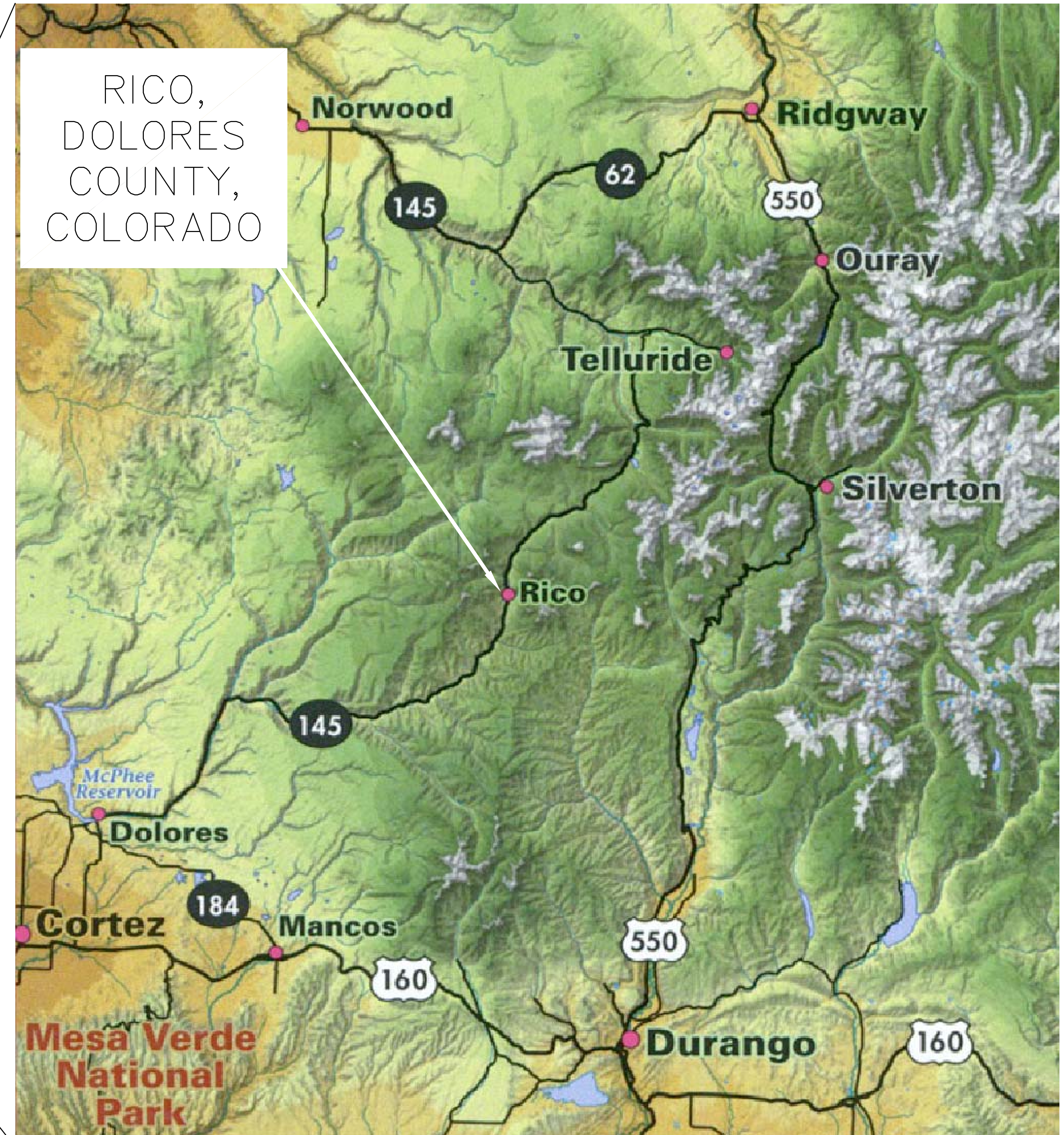


General Notes

N

No.	Revision/Issue	Date

BP-RM

ANDERSON
ENGINEERING COMPANY, INC.

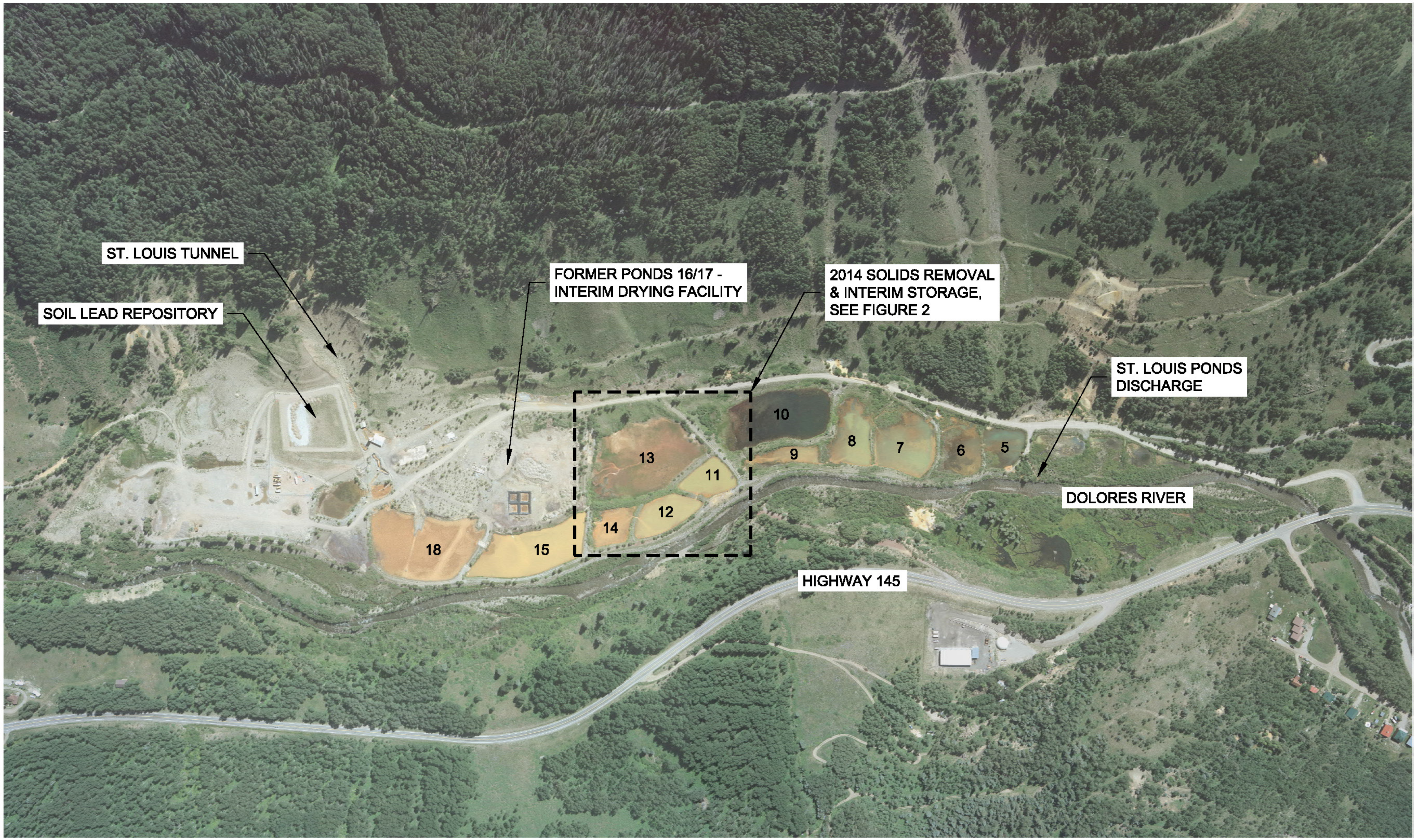
RICO-ARGENTINE MINE SITE

SITE LOCATION

RICO,
DOLORES, COLORADO

DRAWN BY:	BEL
ENGINEER:	SDA
APPROVED:	CES

Project	Sheet L-1
Date 11-Jul-14	
Scale N.T.S.	



01 LOCATION MAP

SCALE - 1" = 400'

N

SCALE IN FEET
0 200 400

General Notes

No.	Revision/Issue	Date

BP

ANDERSON
ENGINEERING COMPANY, INC.

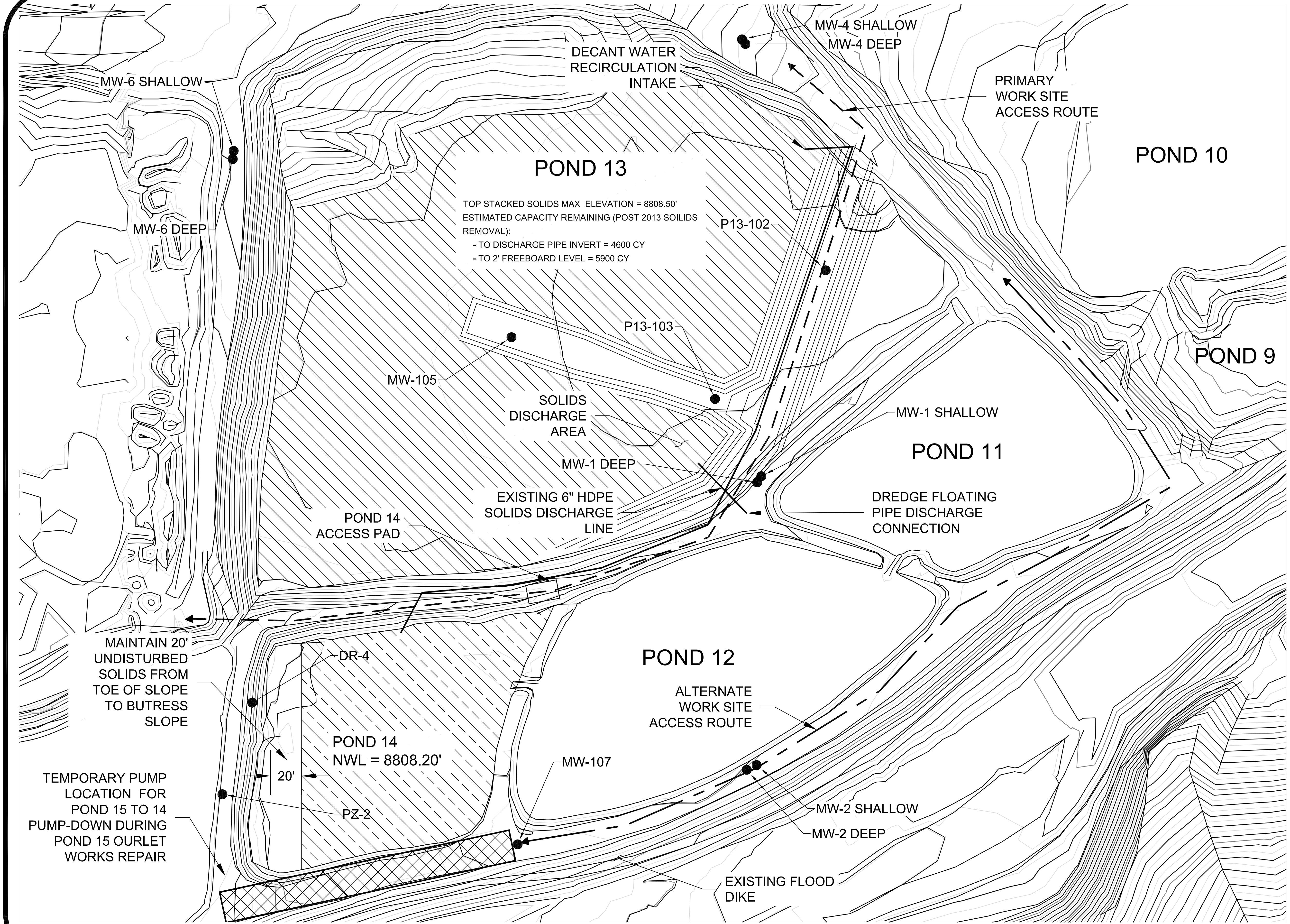
POND 14 SOLIDS REMOVAL

LOCATION MAP

RICO
COLORADO

DRAWN BY:	MAD
ENGINEER:	MAD
APPROVED:	CES

Project	Sheet
Date 22-Apr-14	1
Scale 1" = 400'	



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D:\2014 Solids removal Maps\Work area map.dwg

General Notes

NOTES

1. DO NOT DISTURB EXISTING MONITORING WELLS, BENCHMARKS, OR OTHER APPURTENANCES

LEGEND

- POND 13 INTERIM SOLIDS STORAGE
- POND 14 SOLIDS REMOVAL
- AREA TO BE CLEARED, GRUBBED, AND GRADED FOR DREDGE ANCHOR BLOCKS
- MONITORING WELL (DO NOT DISTURB)

SCALE IN FEET
0 30 60

No.	Revision/Issue	Date

BP

ANDERSON
ENGINEERING COMPANY, INC.
977 WEST 2100 SOUTH
SALT LAKE CITY, UTAH 84119
(801) 972-6222

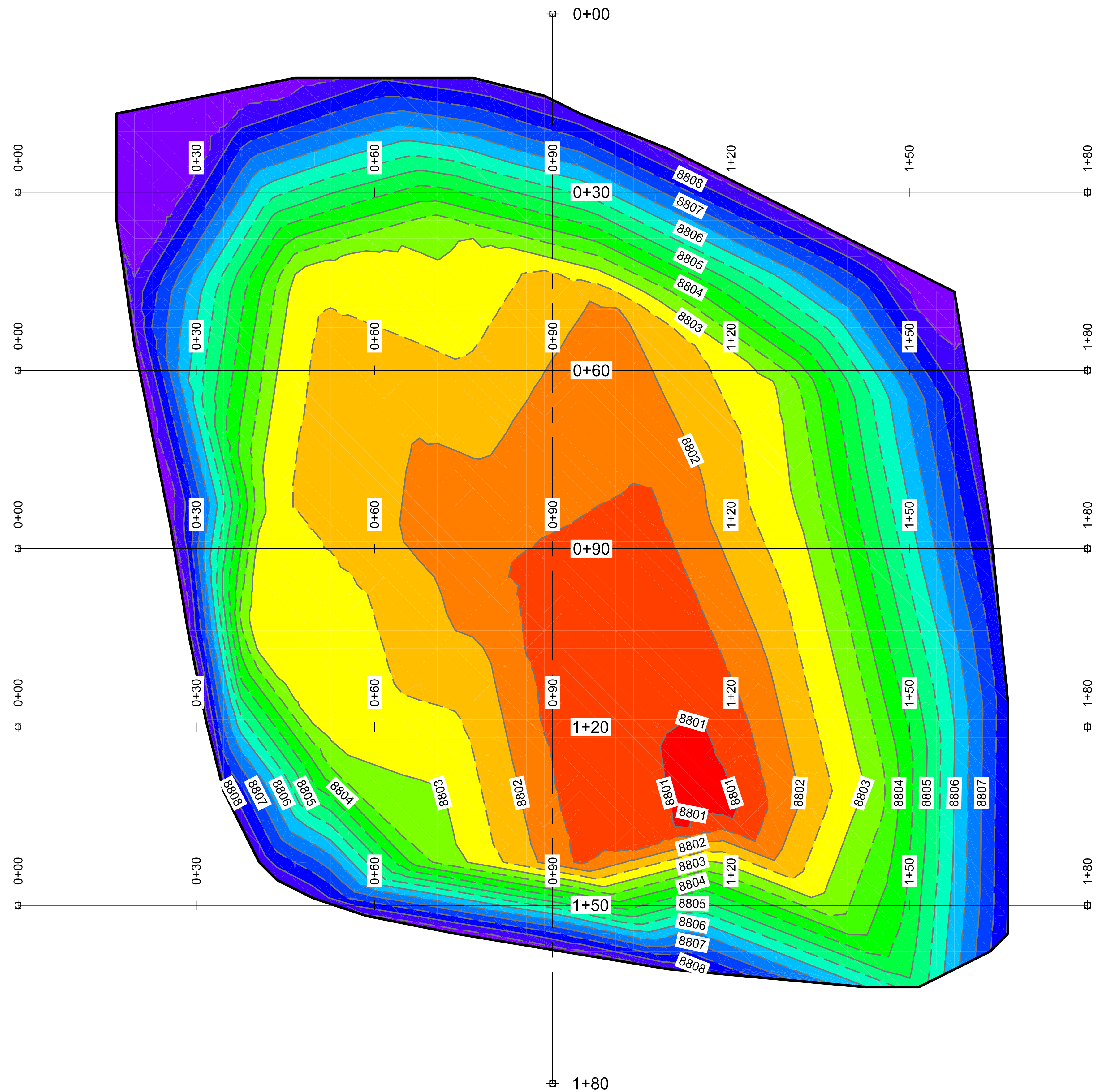
POND 14 SOLIDS
REMOVAL

WORK AREA MAP

RICO
COLORADO

DRAWN BY:	MAD
ENGINEER:	MAD
APPROVED:	CES

Project	Sheet
Date 11-Jul-14	2
Scale 1" = 60'	



Levels Table

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7	8803.000	8803.500	
8	8803.500	8804.000	
9	8804.000	8804.500	
10	8804.500	8805.000	
11	8805.000	8805.500	
12	8805.500	8806.000	
13	8806.000	8806.500	
14	8806.500	8807.000	
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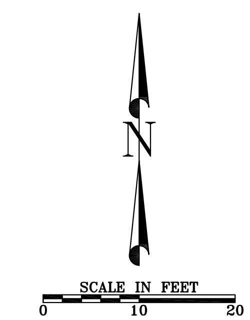
16	8807.500	8808.000	
17	8808.000	8808.500	
18	8808.500	8809.000	

General Notes



No.	Revision/Issue	Date

BP

ANDERSON ENGINEERING COMPANY, INC.

RICO

TOP OF ALLUVIUM, POND 14

RICO
CCOLORADO

DRAWN BY:	MAD
ENGINEER:	MAD
APPROVED:	CES

Project		Sheet
Date	21-Apr-14	3
Scale	1" = 20'	

3 TOP OF ALLUVIUM, POND 14

SCALE - 1" = 20'

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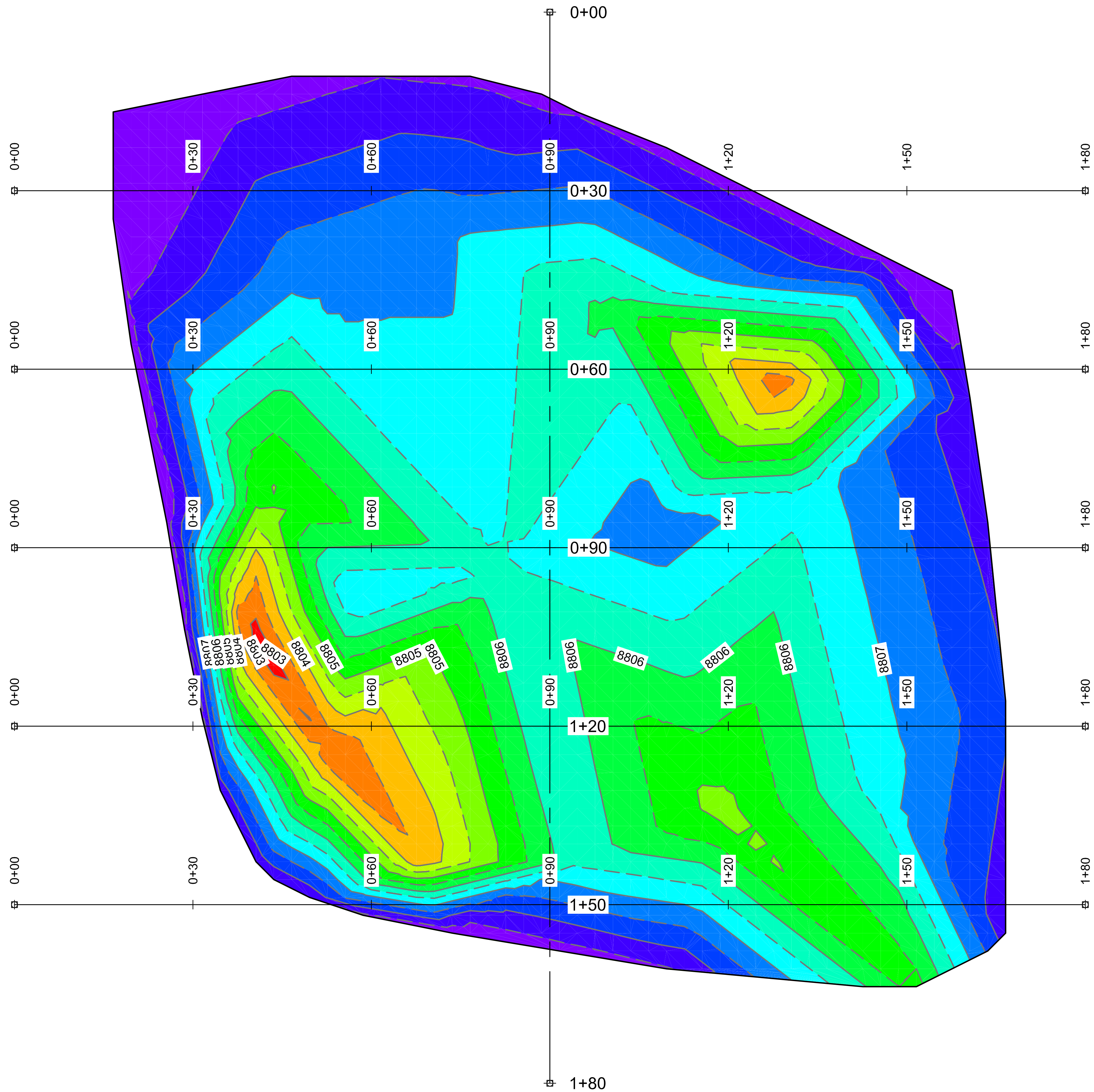

Levels Table

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9	8806.000	8806.500	
10	8806.500	8807.000	
11	8807.000	8807.500	
12	8807.500	8808.000	
13	8808.000	8808.500	
14	8808.500	8809.000	

4 TOP OF CALCINES, POND 14

SCALE - 1" = 20'

General Notes

1. TOTAL VOLUME OF CALCINES ABOVE ALLUVIUM BOTTOM = 1715 CUBIC YARDS

TOTAL ESTIMATED CALCINES REMOVAL WHILE LEAVING 2 FT SOLIDS/CALCINE SEEPAGE CONTROL LAYER = 700 CUBIC YARDS

N

SCALE IN FEET 0 10 20

No.	Revision/Issue	Date

BP

ANDERSON ENGINEERING COMPANY, INC.

RICO

TOP OF CALCINES, POND 14

RICO CCOLORADO

DRAWN BY:	MAD
ENGINEER:	MAD
APPROVED:	CES

Project	
Date	21-Apr-14
Scale	1" = 20'
Sheet	4

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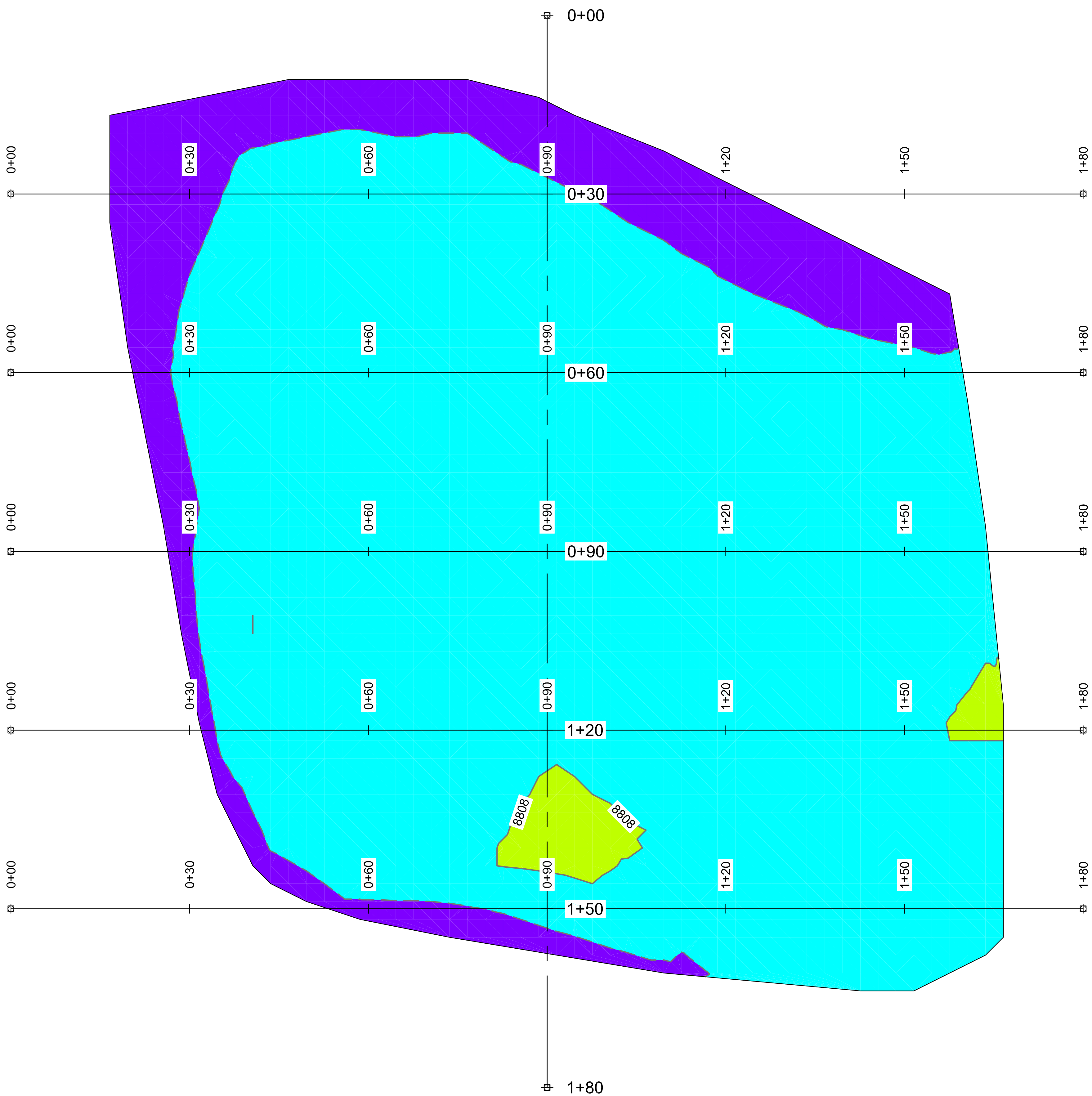

Levels Table

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2	8807.500	8808.000	
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5 TOP OF SOLIDS, POND 14

SCALE - 1" = 20'

General Notes

1. TOTAL VOLUME OF POND SOLIDS ABOVE CALCINE LAYER = 1160 CUBIC YARDS.

TOTAL ESTIMATED SOLIDS REMOVAL WHILE LEAVING 2 FT SOLIDS/CALCINE SEEPAGE CONTROL LAYER = 950 CUBIC YARDS

N

SCALE IN FEET
0 10 20

No.	Revision/Issue	Date

BP

ANDERSON
ENGINEERING COMPANY, INC.

RICO

TOP OF SOLIDS, POND 14

RICO
CCOLORADO

DRAWN BY:	MAD
ENGINEER:	MAD
APPROVED:	CES

Project		Sheet
Date	21-Apr-14	5
Scale	1" = 20'	

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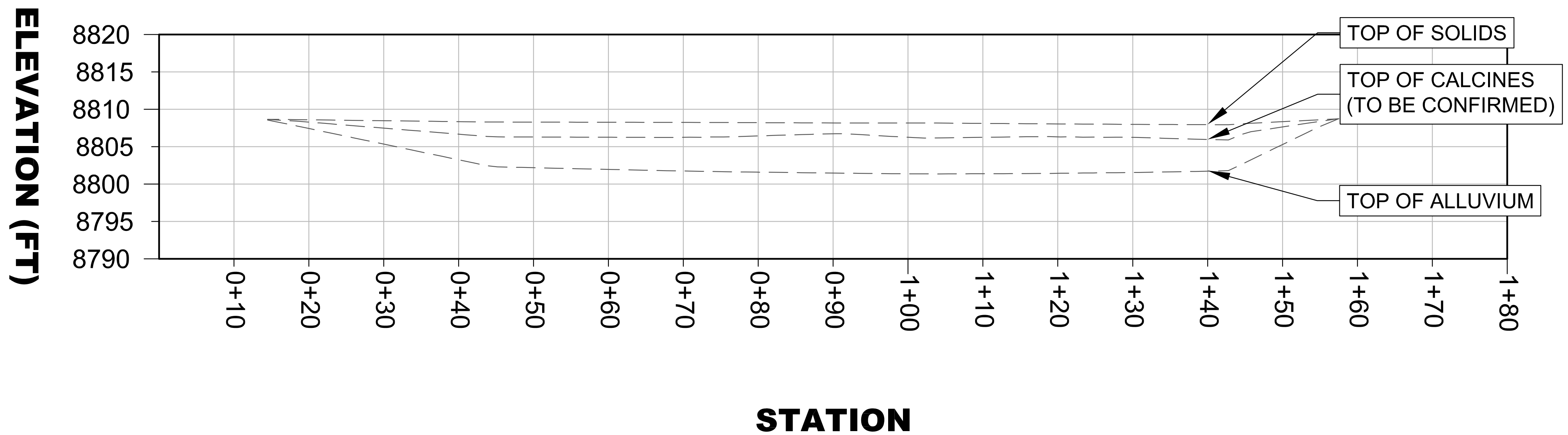


PROFILE VIEW OF N-S ALIGNMENT
0+00 TO 1+80.00
(VERTICAL EXAGGERATION = 1:1)

6 **N-S ALIGNMENT, POND 14**
SCALE - 1" = 20'

General Notes

SCALE IN FEET 0 10 20

No.	Revision/Issue	Date

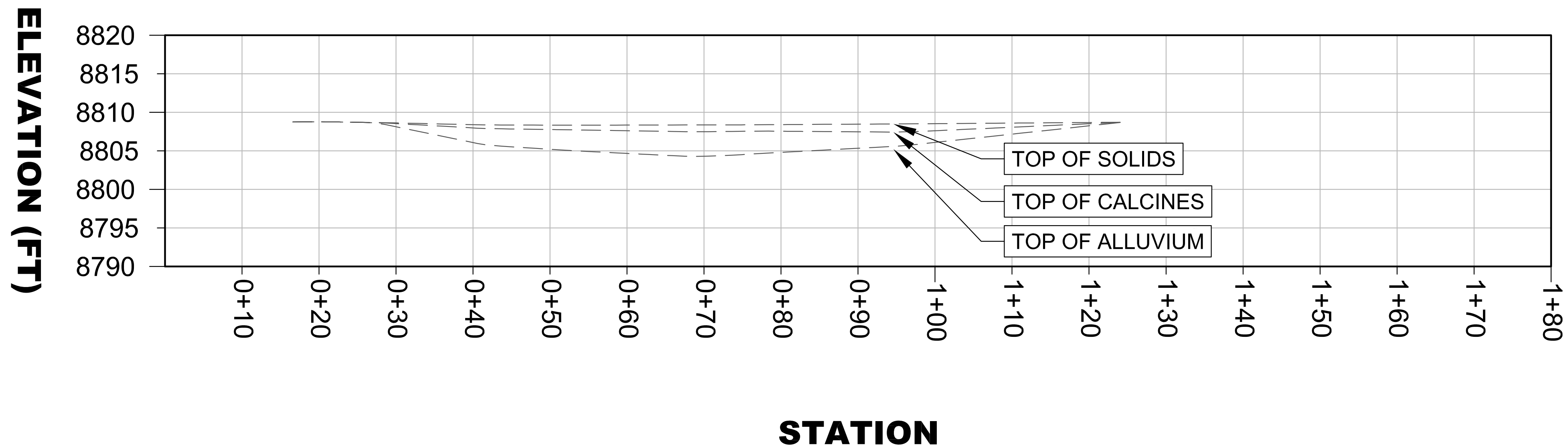
BP

ANDERSON ENGINEERING COMPANY, INC.

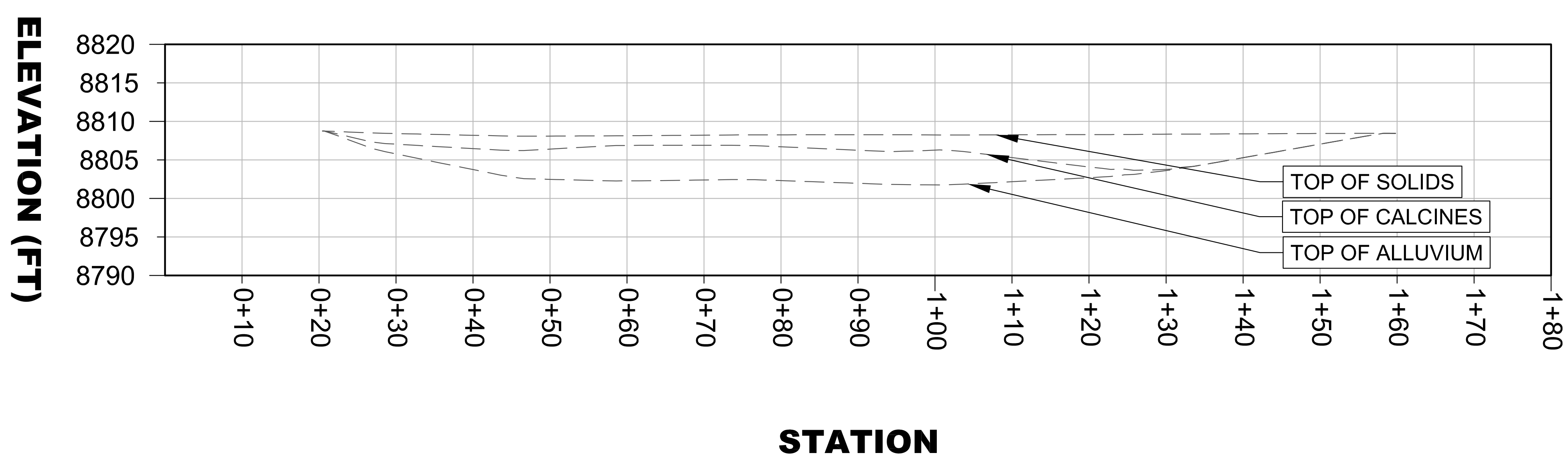
RICO
N-S ALIGNMENT, POND 14
RICO
CCOLORADO

DRAWN BY:	MAD
ENGINEER:	MAD
APPROVED:	CES

Project	Sheet 6
Date 21-Apr-14	
Scale 1" = 20'	



PROFILE VIEW OF STA 0+30 OF N-S ALIGNMENT
0+00 TO 1+80.00
(VERTICAL EXAGGERATION = 1:1)



PROFILE VIEW OF STA 0+60 OF N-S ALIGNMENT
0+00 TO 1+80.00
(VERTICAL EXAGGERATION = 1:1)

7 **STA 0+30 AND 0+60 POND 14**
SCALE - 1" = 20'

General Notes

SCALE IN FEET
0 10 20

No.	Revision/Issue	Date

BP

ANDERSON
ENGINEERING COMPANY, INC.

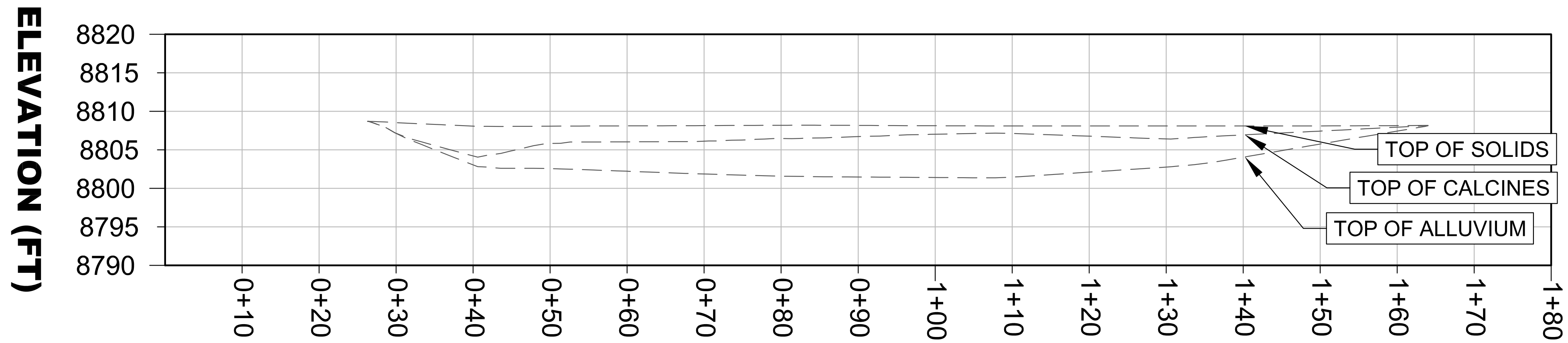
RICO

STA 0+30 AND 0+60, POND 14

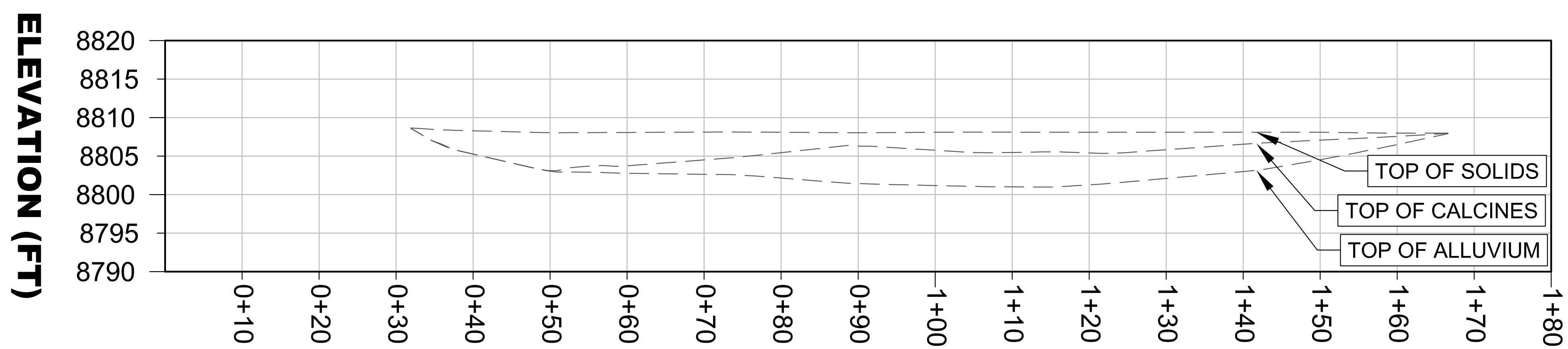
RICO
CCOLORADO

DRAWN BY:	MAD
ENGINEER:	MAD
APPROVED:	CES

Project	
Date	21-Apr-14
Scale	1" = 20'
Sheet	7



PROFILE VIEW OF STA 0+90 OF N-S ALIGNMENT
0+00 TO 1+80.00
(VERTICAL EXAGGERATION = 1:1)



PROFILE VIEW OF STA 1+20 OF N-S ALIGNMENT
0+00 TO 1+80.00
(VERTICAL EXAGGERATION = 1:1)

8 **STA 0+90 AND 1+20 POND 14**

SCALE - 1" = 20'

General Notes

SCALE IN FEET
0 10 20

No.	Revision/Issue	Date

BP

ANDERSON
ENGINEERING COMPANY, INC.

RICO

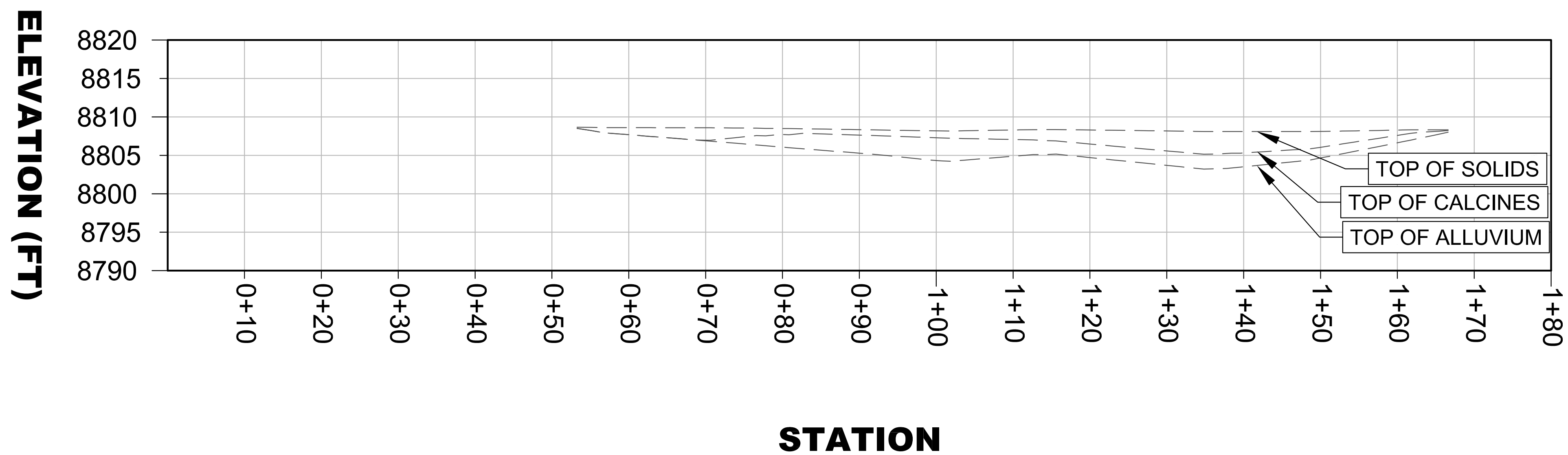
STA 0+90 AND 1+20, POND 14

RICO
CCOLORADO

DRAWN BY:	MAD
ENGINEER:	MAD
APPROVED:	CES

Project	Sheet
Date 21-Apr-14	8
Scale 1" = 20'	

C:\Users\AECI-MD\Documents\AECI\RICO\2014 work\Pond 14 Solids Removal\Pond 14\20131106 Pond 14.dwg



PROFILE VIEW OF STA 1+50 OF N-S ALIGNMENT
0+00 TO 1+80.00
(VERTICAL EXAGGERATION = 1:1)

9 **STA 1+50, POND 14**

SCALE - 1" = 20'

General Notes

SCALE IN FEET 0 10 20

No.	Revision/Issue	Date

BP

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SALT LAKE CITY, UTAH 84119
(801) 972-6222

RICO

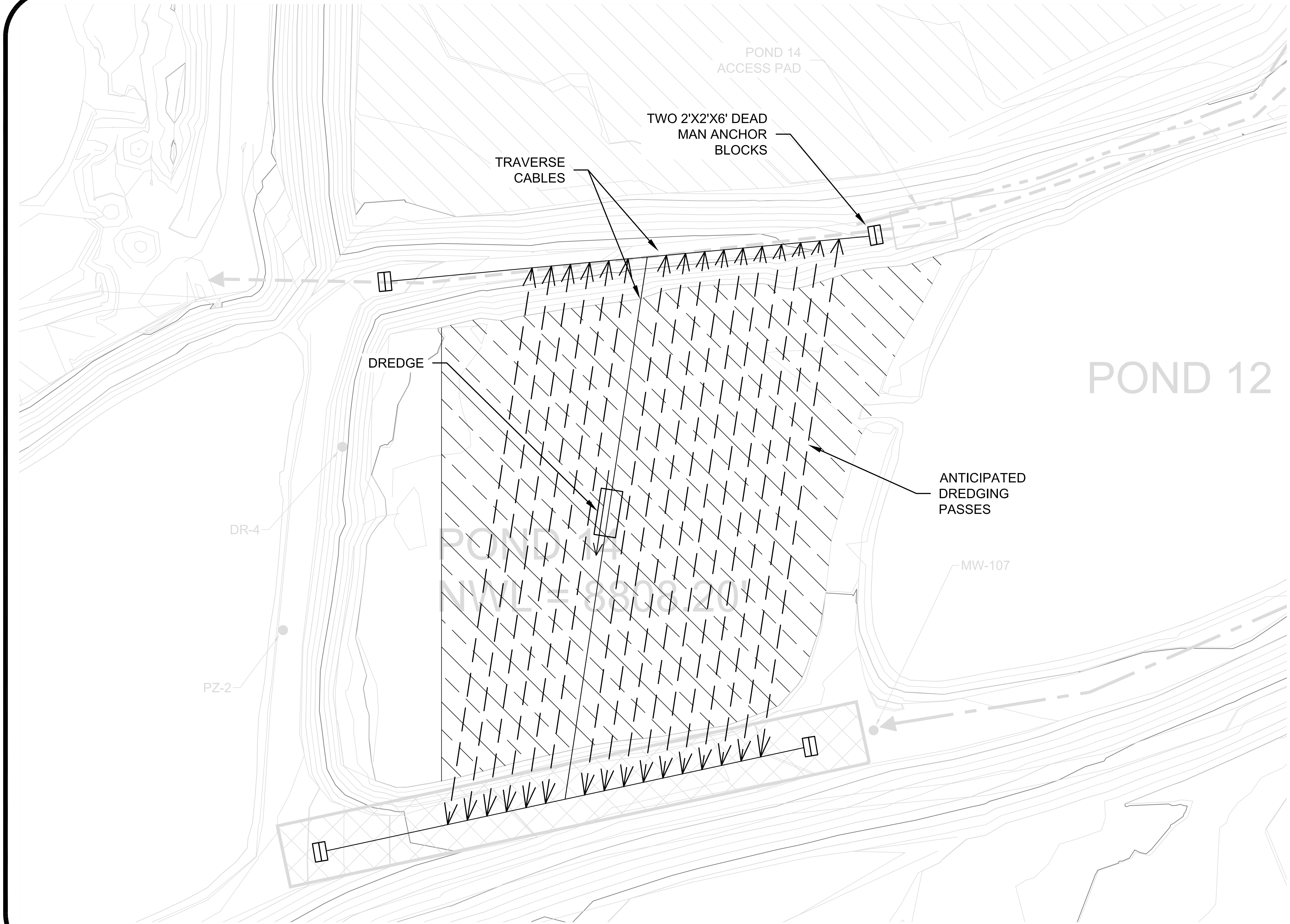
STA 1+50, POND 14

RICO
CCOLORADO

DRAWN BY:	MAD
ENGINEER:	MAD
APPROVED:	CES

Project
Date 21-Apr-14
Scale 1" = 20'
Sheet 9

C:\Users\AECI-MD\Documents\AECI\RICO\2014 work\Pond 14 Solids Removal\Pond 14\20131106 Pond 14.dwg



General Notes

NOTES

1. DREDGE PASSES ARE 6' APART TO ALLOW FOR OVERLAP.
2. DREDGE OPERATES IN ONE DIRECTION ONLY (EAST TO WEST) AS INDICATED. MOVEMENT FROM WEST TO EAST IS ONLY TO REPOSITION AND RESET DREDGE FOR NEXT PASS.

LEGEND

- POND 13 INTERIM SOLIDS STORAGE
- POND 14 SOLIDS REMOVAL
- AREA TO BE CLEARED, GRUBBED, AND GRADED FOR DREDGE ANCHOR BLOCKS
- MONITORING WELL (DO NOT DISTURB)

SCALE IN FEET
0 15 30

No.	Revision/Issue	Date

BP

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POND 14 SOLIDS REMOVAL

TRAVERSE CABLE DIAGRAM

RICO
COLORADO

DRAWN BY:	MAD
ENGINEER:	MAD
APPROVED:	CES

Project	Sheet 10
Date 26-Jun-14	
Scale 1" = 30'	

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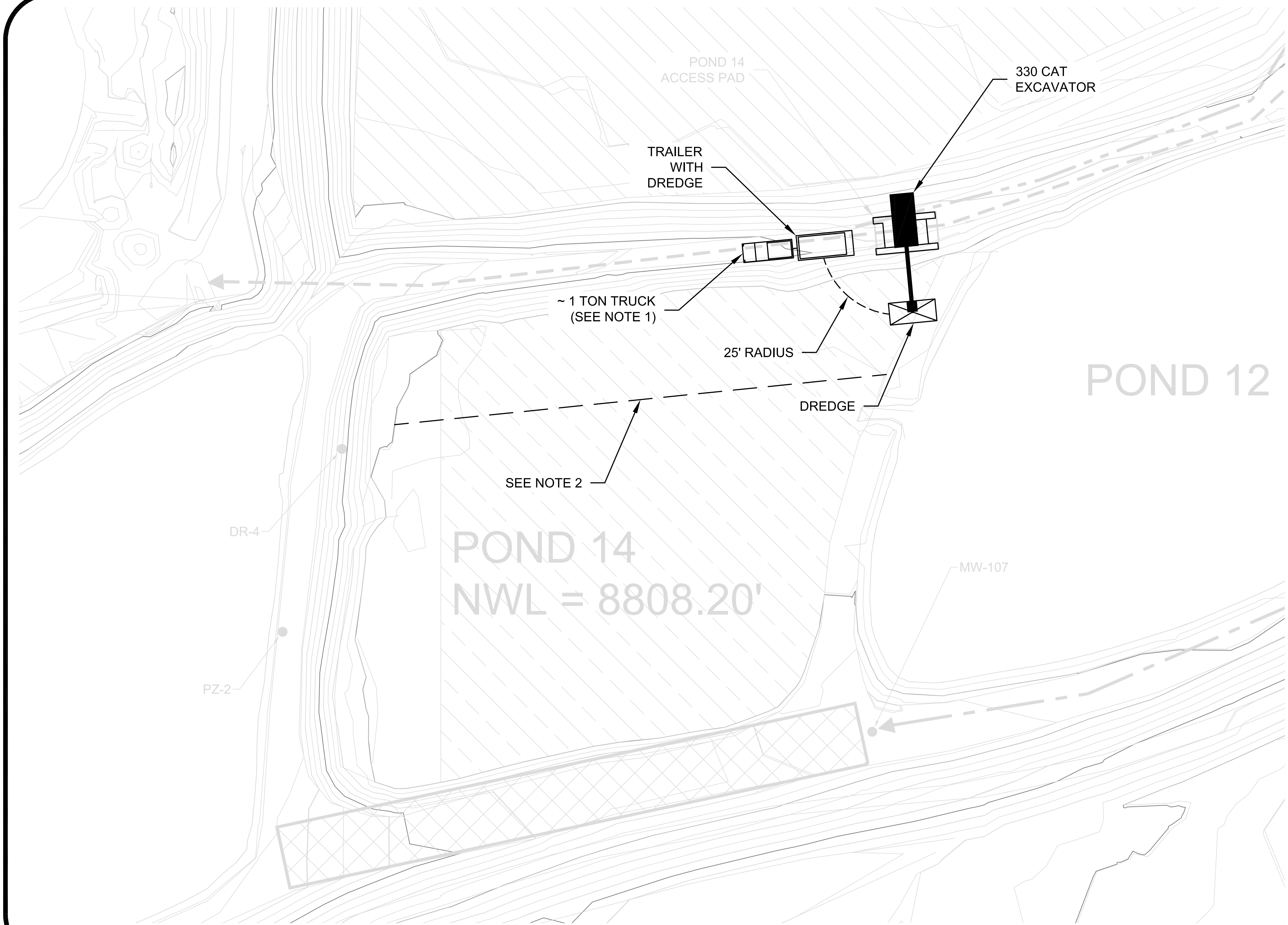

General Notes

NOTES

1. TRUCK AND TRAILER TO TRAVEL IN FORWARD DIRECTION AT ALL TIMES (DO NOT BACKUP). SITE ACCESS PERMITS INGRESS AND EGRESS AT MULTIPLE LOCATIONS TO FACILITATE FORWARD-ONLY MOVEMENT

2. EASTERN 30 FEET (APPROXIMATELY) OF POND SOLIDS TO BE REMOVED PRIOR TO PLACEMENT OF DREDGE IN ORDER TO PROVIDE ADEQUATE DEPTH TO FLOAT DREDGE (1.5' MIN DEPTH).

LEGEND

- POND 13 INTERIM SOLIDS STORAGE
- POND 14 SOLIDS REMOVAL
- AREA TO BE CLEARED AND GRUBBED, AND GRADED FOR DREDGE ANCHOR BLOCKS
- MONITORING WELL (DO NOT DISTURB)

N

SCALE IN FEET
0 15 30

No.	Revision/Issue	Date

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POND 14 SOLIDS REMOVAL

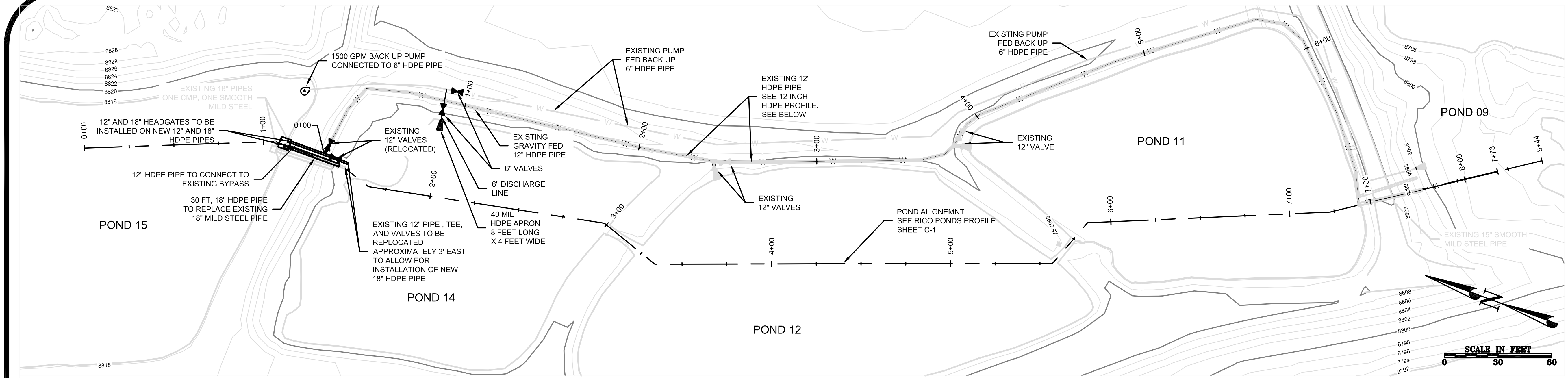
DREDGE LIFT AND DEPLOYMENT

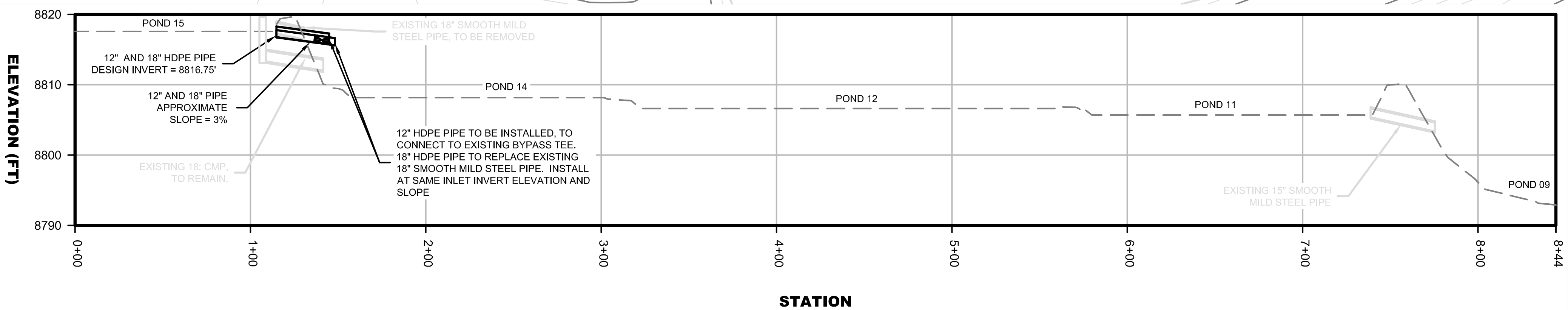
RICO
COLORADO

DRAWN BY:	MAD
ENGINEER:	MAD
APPROVED:	CES

Project	
Date	26-Jun-14
Scale	1" = 30'
Sheet	11

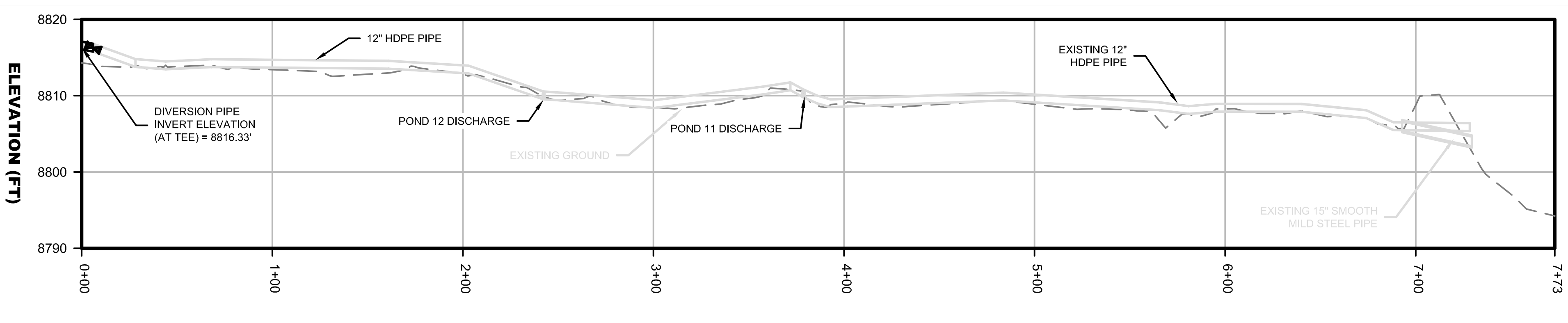
C:\Users\AECI-MD\Documents\AECI\RICO\2014 work\Pond 14 Solids Removal\Drawings\Work area lift setup.dwg





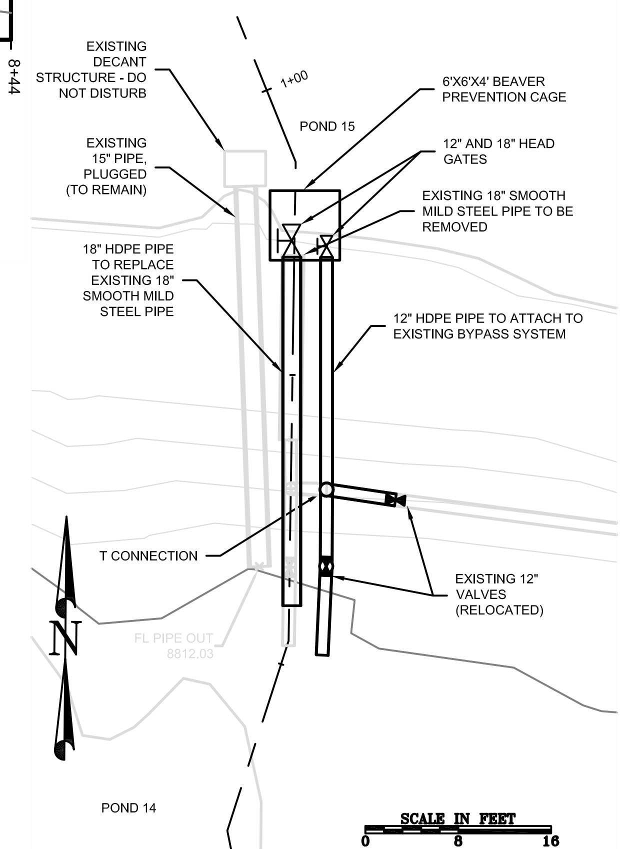
PROFILE VIEW OF RICO PONDS
0+00 TO 8+44.40
(VERTICAL EXAGGERATION = 4:1)

SCALE IN FEET
0 40 80



PROFILE VIEW OF EXISTING 12 INCH HDPE PIPE
0+00 TO 7+72.96
(VERTICAL EXAGGERATION = 4:1)

SCALE IN FEET
0 40 80



01 POND 14 DISCHARGE DETAIL
SCALE - 1" = 8'

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General Notes

NOTES:

No.	Revision/Issue	Date

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RICO PONDS 15-9 DIVERSION

PLAN VIEW, PROFILES AND DETAILS

RICO, DOLORES COUNTY, CO

DRAWN BY:	CAS, MAD
ENGINEER:	DBJ, MAD
APPROVED:	CS

Project	Sheet
Date 2014-04-17	C-1
Scale AS SHOWN	

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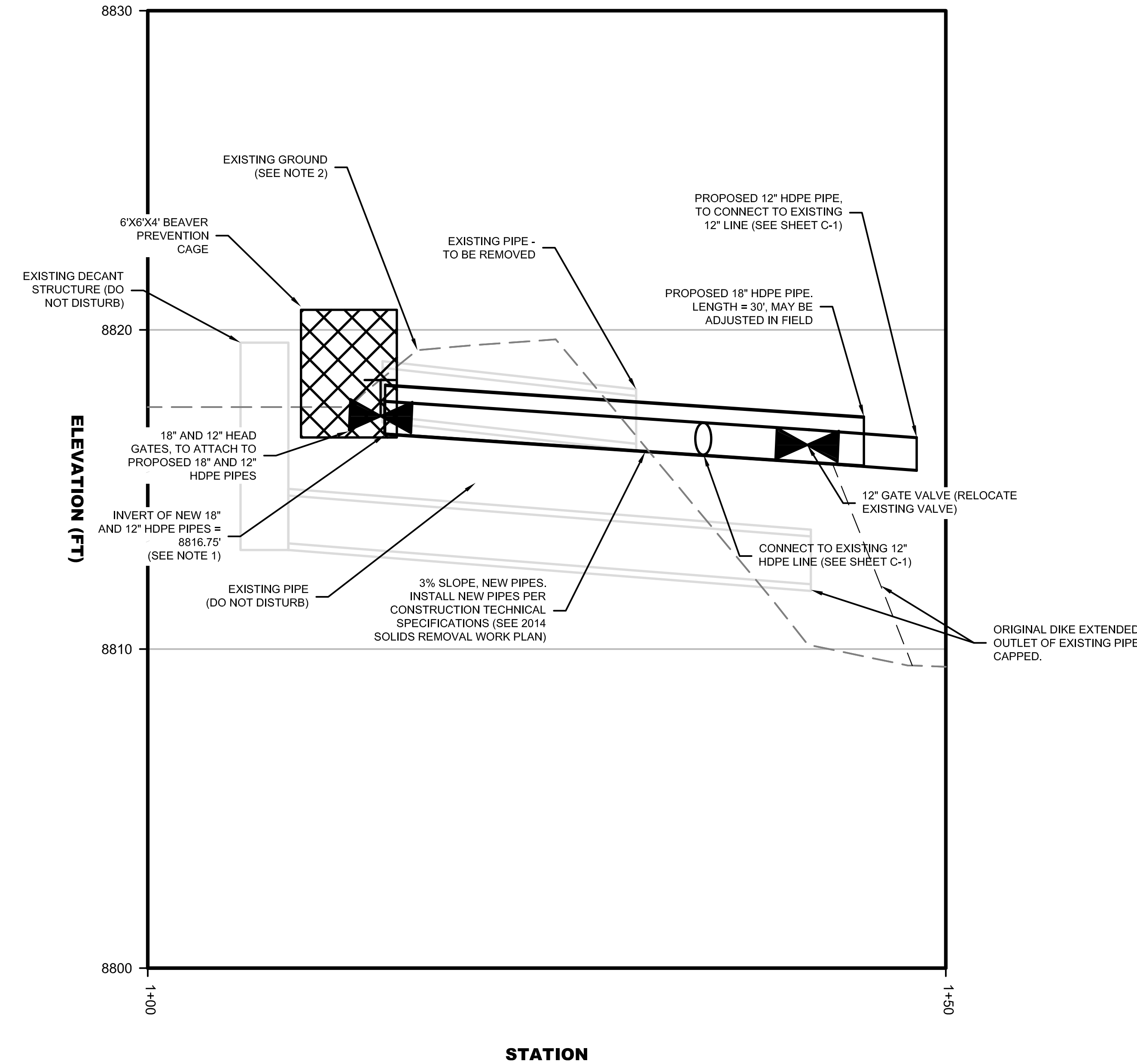

PROFILE VIEW OF RICO PONDS
1+00 TO 1+50.00
(VERTICAL EXAGGERATION = 2:1)

SCALE IN FEET
0 4 8

General Notes

NOTES:

1. NEW PIPES INVERTS TO BE INSTALLED 6" BELOW EXISTING UPPER PIPE INVERT.
2. EXISTING GROUND PROFILE SHOWN REFLECTS ORIGINALLY SURVEYED CONDITIONS (2011). ACTUAL GROUND PROFILE MAY VARY.

No.	Revision/Issue	Date

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RICO PONDS 15-9 DIVERSION

PIPE MODIFICATIONS PROFILE

RICO,
DOLORES COUNTY, CO

DRAWN BY:	CAS, MAD
ENGINEER:	DBJ, MAD
APPROVED:	CS

Project	Sheet
Date 2014-04-17	C-2
Scale AS SHOWN	

D:\2014 Solids removal Maps\20140722 Pond 15-9 Diversion updated.dwg

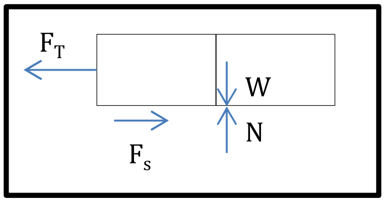
ATTACHMENT 2

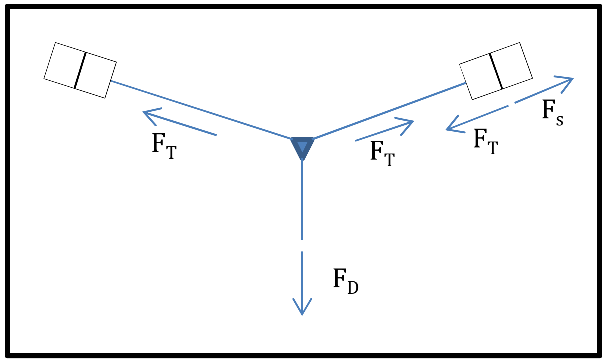
Design Computations

Dead Man Anchor Calculations and Layout

Rico, Colorado Pond 15 Dredge Dead Man Anchor Calculations:

Definitions





F_S = Static friction force

$F_{S,\ MAX}$ = Maximum static friction force

F_T = Tensile force in traverse cable

F_D = Maximum pulling force from winch hoist, first wrap = 3810 lb

W = Weight of barrier

µ = Coefficient of static friction

N = Normal force

Calculations

W = N = 7,200 lb (Two 2'x2'x6' concrete blocks @ 3,600 lb each)

$F_{S,\ MAX}$ = µW = (0.3)(7,200lb) = **2160** lb

F_T must be less than $F_{S,MAX}$

$F_T = 0.5F_D$ = (0.5)(3810lb) = **1905** lb

$F_T < F_S$ - <u>Blocks will not slide</u>

Conclusions and Recommendations

The tensile force exerted on each dead man anchor must be less than the friction force between the anchor and the ground surface. The maximum tensile force that the dredge winch hoist can exert on the cable could possibly be achieved if full power were given to the dredge and the dredge became stuck. The force exerted on each anchor is half the dredge winch hoist pull force since it is split between two anchors. The calculations indicate that the force exerted on each anchor is **not** greater than the maximum friction force, therefore **the anchors will not move**.

In addition, the chains holding cables to the blocks and the pin shackles connecting the chains to the cables must be rated to **3000 lb** (Factor of Safety of ~1.5). The cable must be rated for **5000 lb** (3810 lb + ~30% FS).

Technical Memo – Pond 15 to Pond 9 Diversion and Water Management

TECHNICAL MEMO

POND 15 to POND 9 DIVERSION AND WATER MANAGEMENT

RICO, DOLORES COUNTY, COLORADO

CLIENT:
BP/AR

PREPARED BY:

ANDERSON ENGINEERING
977 WEST 2100 SOUTH
SALT LAKE CITY, SALT LAKE COUNTY, UTAH
PHONE: 801-972-6222
WEBSITE: WWW.ANDERSONENG.COM

ANDERSON
ENGINEERING COMPANY INC.

JUNE, 2014

1.0 INTRODUCTION

The purpose of this report is to provide information relating to the existing diversion pipeline bypassing Ponds 14, 12 and 11 of the St. Louis pond system. The location of pipe begins on the south side of Pond 15, continuing south on the east side of Ponds 14, 12 and 11 for approximately 700 feet with discharge laterals into Ponds 12 and 11 and an outfall into Pond 9. The following report includes a description of the existing and proposed drainage conditions, as well as supporting calculations and recommendations See C-1 in the Appendix.

2.0 PURPOSE AND SCOPE

Currently, Pond 14 is prepared for removal of solids resulting from settlement of the St. Louis mine water discharge. The solids are to be removed by a dredging operation. Pond 14 will be used for recirculation of dredge water as well as being scheduled for solids removal in 2014. Ponds 14, 12 and 11 are three of multiple ponds used for treating water runoff from the St. Louis mine shaft. While removing the sediment from Pond 14, the mine discharge water will be diverted around the ponds allowing the removal to take place. Therefore, a diversion pipe has been placed from Pond 15 to Pond 9, to avoid drainage into Ponds 14, 12 and 11 if needed. In the event Pond 15 begins to over-fill during an excessive storm event, there will be a back- up pump and an additional pipeline leading from Pond 15 to Pond 9. Once the sediment removal is completed, the diversion pipeline and pumps will be removed and regular discharge between ponds resume.

3.0 RAINFALL DATA

Rainfall data was provided by Autodesk Storm and Sanitary Analysis 2013 (SSA) and verified by the NOAA Atlas 2 Volume III, Figure 29. The 25-year storm was modeled using a SCS Type II 24 Hr storm. Assigned rainfall depth for the 25-year storm for the St Louis Pond area near Rico, CO is as follows:

25-Year/24 Hr Storm = 2.90 Inches

4.0 CONTRIBUTING FACTORS

The first contributing factor to the total volume of pond water discharge is the outflow from the St. Louis mine adit. The runoff from the mine adit is being diverted into Pond 15 and through pond 15 with a seasonal historical peak flow of **2.90 CFS** as derived from 2008 to present.

During a 25 year SCS Type II 24 Hr storm, only the rain that falls within the area of the ponds is collected. A diversion structure has been constructed to route storm run-off around the subject ponds and will not contribute to the water budget for the pipeline bypass. The pond areas and increased volumes are calculated below.

Pond 18 = 2.25 ac.

Increased Volume = 2.25 ac. x 2.9 inches = 23,685.75 CF

Pond 15 is 2.00 ac.

Increased Volume = 2.00 ac. x 2.9 inches = 21,054 CF

The maximum increase of water volume from Pond 18 and a maximum increase of water volume from Pond 15 during a 24 Hr. period will not reach outlets at the same time. Therefore only the larger of the two volume increases will be considered.

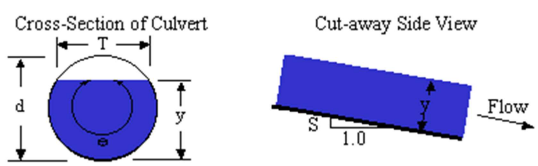
5.0 STORM EVENT MODEL

While maintaining a constant **2.90 CFS** from mine adit outflow, the additional volume from the 2.9 inch 25 year/24 hr storm will be contained by the ponds and passed through the system.

6.0 DIVERSION PIPE CALCULATIONS

The peak flow of **2.90 CFS** from the tunnel outflow and the 2.9 inch 25-year/24 hr storm is detained within the excess storage volume of Pond 18 and Pond 15. The extra volume causes the water elevation in Pond 18 and 15 to rise, increasing the discharge outflow. A summary of storm water discharge through the diversion within the system is as follows:

ASSUMPTIONS:



Pipe Flow, $Q = \frac{1.49}{n} AR^{\frac{2}{3}} S^{\frac{1}{2}}$

Pipe Velocity, $V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$

Hydraulic Radius, $R = \frac{A}{P}$

Area of Water Flow, $A = \frac{1}{8} (\theta - \sin\theta) D^2 \; (ft^2)$

θ = Central Angle (radians)

D = Pipe Diameter (ft)

Wetted Perimeter, $P = \frac{1}{2}\ \theta D$
θ = Central Angle (radians)
D = Pipe Diameter (ft)

Pipe Slope, S = .02 (ft/ft)
Mannings Roughness, n = 0.011 for Plastic Pipe
D = 1.00 ft, 12 in.
y = 0.50 ft, 6 in.
$\theta = 180°$ for pipe half full

CALCULATIONS (12" diameter, 6" full, 2.0 %):

$A = \frac{1}{8}\ (\theta - \sin\theta)\, D^2 = \frac{1}{8}\ (\pi - \sin\pi)\ 0.50^2 = \underline{0.39\ ft^2}$

$P = \frac{1}{2}\ \theta D = P = \frac{1}{2}\ \pi\ \ 0.6667 = \underline{1.57\text{ ft}}$

$R = \frac{A}{P} = \frac{0.17452}{1.04715} = \underline{0.25}$

$Q = \frac{1.49}{n}\ AR^{\frac{2}{3}} S^{\frac{1}{2}} = Q = \frac{1.49}{0.011}(0.39)(0.25^{\frac{2}{3}})(0.02^{\frac{1}{2}})$ = **2.985 CFS**

WATER DEPTH IN 12" PIPE (FT)	FLOW (CFS) @ 2%
0.5	2.9850
0.6	4.0114
0.7	4.9988
0.8	5.8362
0.9	6.3635
1.0	5.9707

As the water level rises with the increase in the intensity of the storm, the 12" pipe will accommodate the volume with an increased capacity up to 0.9 feet of water depth in the pipe. The added pond volume from storm water can censervitively be discharged through the 12" pipe in addition to the St Louis discharge. The St Louis water at 2.9 CFS and the increased storm water potentially contained in Pond 15 results in a maximum pipe discharge of about 6.0 CFS. The bypass 12 " pipe has a capacity at the slope proposed of 6.36 CFS. When the pipe is flowing full there is a slight drop in capacity but the maximum discharge is within the pipe capacity with minor backwater until drained.

7.0 SUMMARY

The water from Pond 15 is being diverted around Ponds 14 (recirculation pond), 12 and 11 through a 12" gravity flow diversion pipe into Pond 9 allowing the removal of mine sediment that has built up in Pond 14. A secondary 6" supplementary diversion pipeline is also available with a 3.34 CFS (1500 GPM) pump to accommodate any excess flooding of Pond 15 during a unforeseen storm event or to allow for gravity line maintenance. The storm water contained in Pond 18 and 15 from a 25-year/24 hr storm and the mine discharge flow of **2.90 CFS** from the St. Louis mine were calculated (Manning's open channel flow equation) to determine that the flow capacity of the 12" diversion pipe would be adequate to sustain the total amount of bypass water.

RICO PONDS 15-9 DIVERSION AND WATER MANAGEMENT

SHEET INDEX

SHEET C-1 - PLAN VIEW, PROFILES AND DETAILS

SHEET C-2 - PIPE MODIFICATIONS PROFILE

N

SCALE IN FEET
0 200 400

General Notes

No.	Revision/Issue	Date

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977 WEST 2100 SOUTH
SALT LAKE CITY, UTAH 84119

RICO PONDS 15-9
DIVERSION

COVER SHEET

RICO,
DOLORES COUNTY, CO

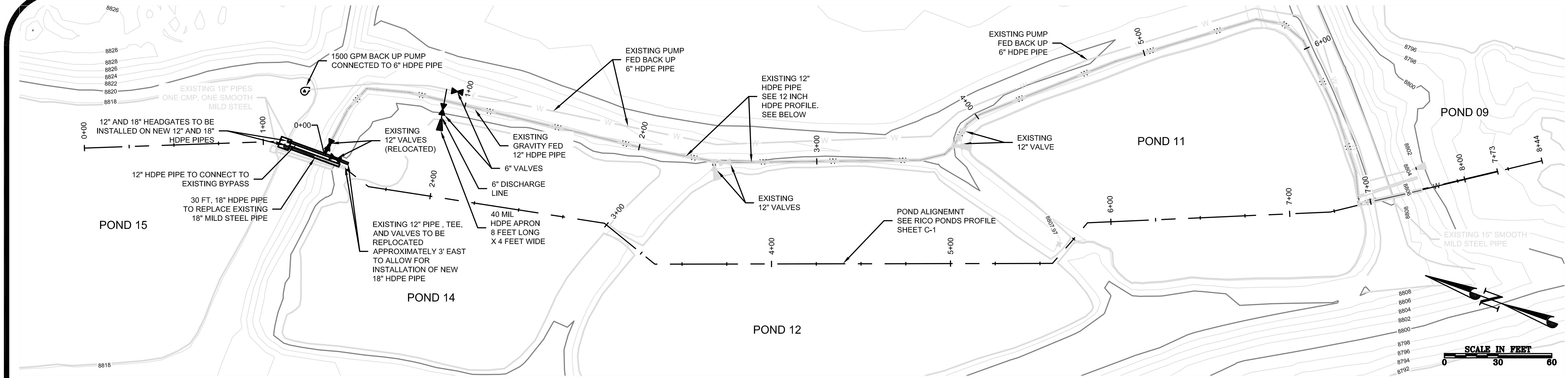
DRAWN BY:	CAS
ENGINEER:	DBJ, MAD
APPROVED:	CS

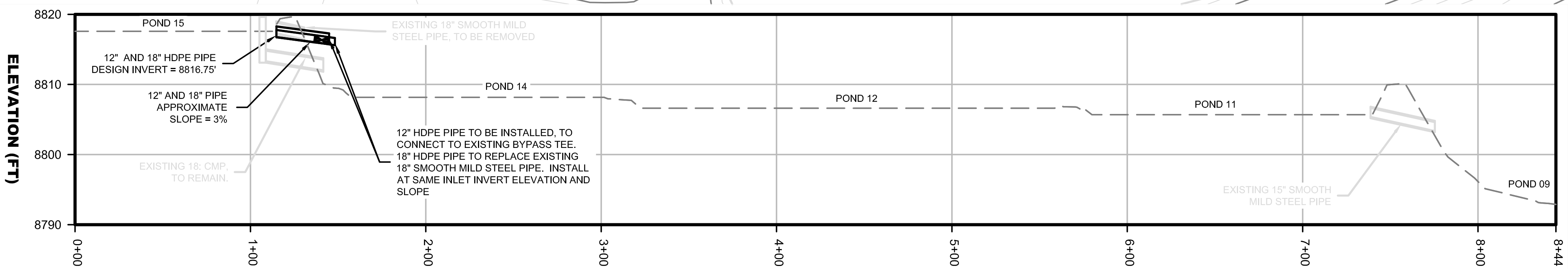
Project

Date 22-Jul-14

Scale 1" = 200'

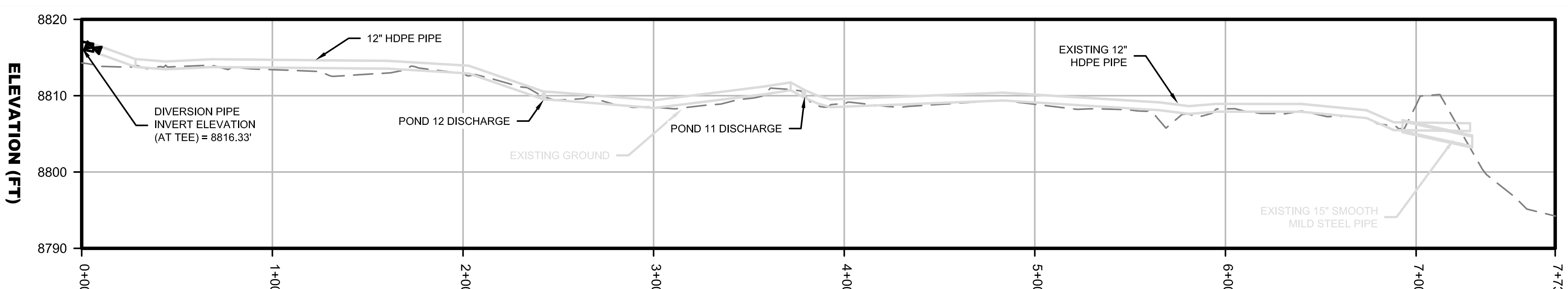
Sheet G-1





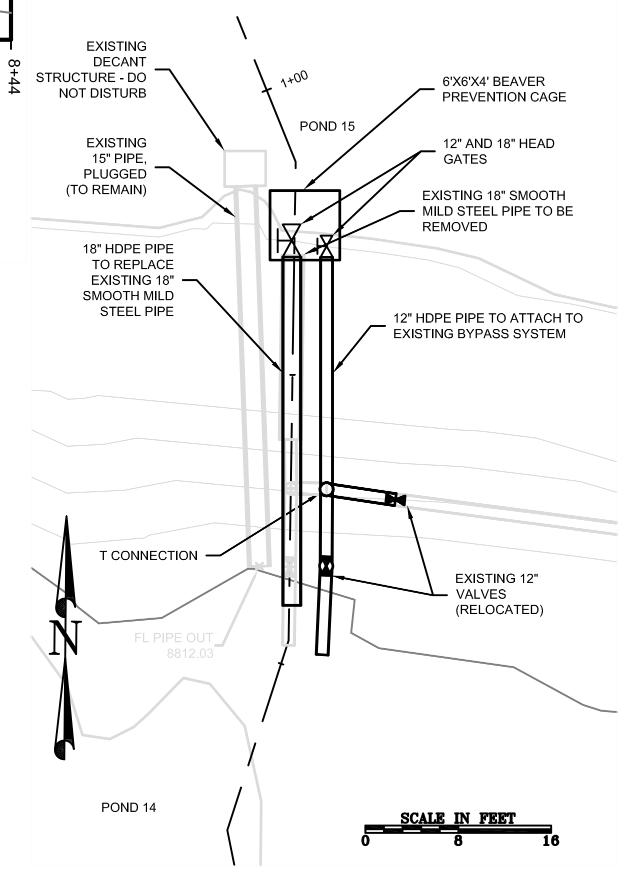
PROFILE VIEW OF RICO PONDS
0+00 TO 8+44.40
(VERTICAL EXAGGERATION = 4:1)

SCALE IN FEET 0 40 80



PROFILE VIEW OF EXISTING 12 INCH HDPE PIPE
0+00 TO 7+72.96
(VERTICAL EXAGGERATION = 4:1)

SCALE IN FEET 0 40 80



01 POND 14 DISCHARGE DETAIL
SCALE - 1" = 8'

General Notes

NOTES:

No.	Revision/Issue	Date

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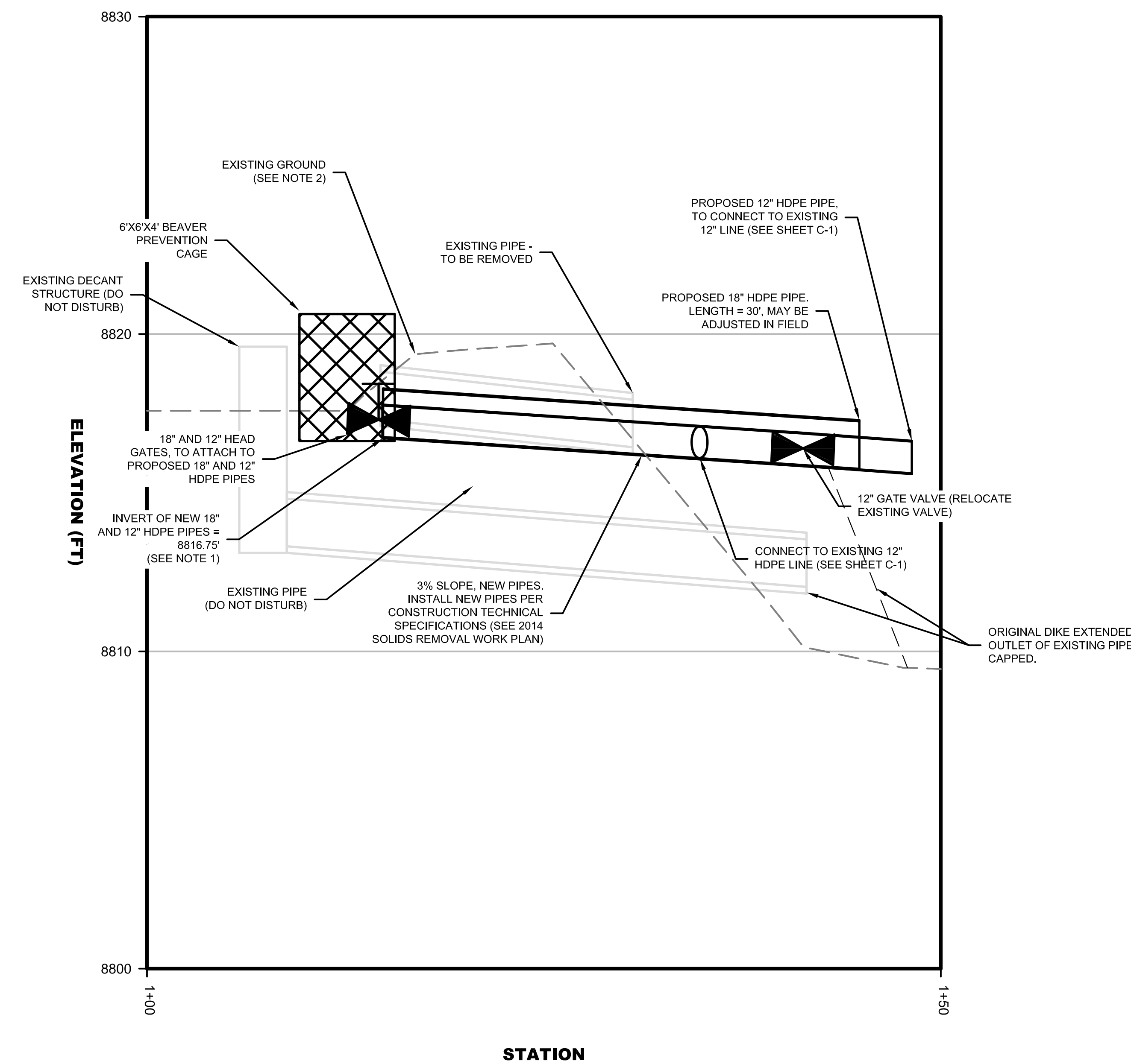
RICO PONDS 15-9 DIVERSION

PLAN VIEW, PROFILES AND DETAILS

RICO, DOLORES COUNTY, CO

DRAWN BY:	CAS, MAD
ENGINEER:	DBJ, MAD
APPROVED:	CS

Project	Sheet C-1
Date 2014-04-17	
Scale AS SHOWN	



PROFILE VIEW OF RICO PONDS
1+00 TO 1+50.00
(VERTICAL EXAGGERATION = 2:1)

SCALE IN FEET
0 4 8

General Notes

NOTES:

1. NEW PIPES INVERTS TO BE INSTALLED 6" BELOW EXISTING UPPER PIPE INVERT.
2. EXISTING GROUND PROFILE SHOWN REFLECTS ORIGINALLY SURVEYED CONDITIONS (2011). ACTUAL GROUND PROFILE MAY VARY.

No.	Revision/Issue	Date

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(801) 972-6222

RICO PONDS 15-9
DIVERSION

PIPE MODIFICATIONS PROFILE

RICO,
DOLORES COUNTY, CO

DRAWN BY:	CAS, MAD
ENGINEER:	DBJ, MAD
APPROVED:	CS

Project	Sheet
Date 2014-04-17	C-2
Scale AS SHOWN	

D:\2014 Solids removal Maps\20140722 Pond 15-9 Diversion updated.dwg

Project Description

File Name .... 130314 Pond 15-09 Diversion.SPF

Project Options

Flow Units .... CFS
Elevation Type .... Elevation
Hydrology Method .... SCS TR-55
Time of Concentration (TOC) Method .... SCS TR-55
Link Routing Method .... Kinematic Wave
Enable Overflow Ponding at Nodes .... YES
Skip Steady State Analysis Time Periods .... NO

Analysis Options

Start Analysis On	Jul 26, 2012	00:00:00
End Analysis On	Jul 28, 2012	00:00:00
Start Reporting On	Jul 26, 2012	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:01:00	days hh:mm:ss
Routing Time Step	1	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins..	1
Nodes..	11
Junctions	9
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links..	10
Channels	0
Pipes	10
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	RAIN_GAGE	Time Series	25 YEAR USER DEFINED	Intensity	inches	None	None	25	2.90	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	POND_18_15_DRAIN	4.25	97.29	2.90	2.59	11.01	15.80	0 00:05:00

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	STRC 01	Junction	8823.11	8824.19	8823.11	8824.19	0.00	1.97	8823.76	0.00	0.43	0 00:00	0.00	0.00
2	STRC 02	Junction	8822.73	8823.80	8822.73	8823.80	0.00	1.97	8823.44	0.00	0.36	0 00:00	0.00	0.00
3	STRC 03	Junction	8822.35	8823.43	8822.35	8823.43	0.00	1.97	8823.07	0.00	0.36	0 00:00	0.00	0.00
4	STRC 04	Junction	8821.39	8822.47	8821.39	8822.47	0.00	1.97	8822.07	0.00	0.40	0 00:00	0.00	0.00
5	STRC 05	Junction	8821.10	8822.17	8821.10	8822.17	0.00	1.97	8821.76	0.00	0.41	0 00:00	0.00	0.00
6	STRC 06	Junction	8820.38	8821.46	8820.38	8821.46	0.00	1.97	8820.93	0.00	0.53	0 00:00	0.00	0.00
7	STRC 07	Junction	8819.31	8820.38	8819.31	8820.38	0.00	1.97	8819.75	0.00	0.63	0 00:00	0.00	0.00
8	STRC 08	Junction	8818.70	8819.77	8818.70	8819.77	0.00	1.97	8819.09	0.00	0.69	0 00:00	0.00	0.00
9	STRC 09	Junction	8817.31	8818.99	8817.31	8818.99	0.00	1.97	8817.70	0.00	1.29	0 00:00	0.00	0.00
10	OUTFALL	Outfall	8812.03					1.97	8812.24					
11	POND_18	Storage Node	8819.69	8826.00	8823.69		0.00	17.58	8824.37				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Reported Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)	
1	PIPE 01	Pipe	POND_18	STRC 01	34.42	8823.19	8823.11	0.2200	12.000	0.0120	1.97	3.64	0.54	2.36	0.52	0.52	0.00	Calculated
2	PIPE 02	Pipe	STRC 01	STRC 02	54.49	8823.11	8822.73	0.7100	12.000	0.0150	1.97	2.60	0.76	3.64	0.65	0.65	0.00	Calculated
3	PIPE 03	Pipe	STRC 02	STRC 03	67.80	8822.73	8822.35	0.5500	12.000	0.0150	1.97	2.30	0.86	3.29	0.71	0.71	0.00	Calculated
4	PIPE 04	Pipe	STRC 03	STRC 04	153.01	8822.35	8821.39	0.6300	12.000	0.0150	1.97	2.45	0.80	3.48	0.68	0.68	0.00	Calculated
5	PIPE 05	Pipe	STRC 04	STRC 05	44.68	8821.39	8821.10	0.6600	12.000	0.0150	1.97	2.51	0.78	3.53	0.67	0.67	0.00	Calculated
6	PIPE 06	Pipe	STRC 05	STRC 06	58.03	8821.10	8820.38	1.2300	12.000	0.0150	1.97	3.42	0.57	4.51	0.54	0.54	0.00	Calculated
7	PIPE 07	Pipe	STRC 06	STRC 07	45.51	8820.38	8819.31	2.3700	12.000	0.0150	1.97	4.75	0.41	5.76	0.45	0.45	0.00	Calculated
8	PIPE 08	Pipe	STRC 07	STRC 08	14.85	8819.31	8818.70	4.1000	12.000	0.0150	1.97	6.25	0.31	7.04	0.39	0.39	0.00	Calculated
9	PIPE 09	Pipe	STRC 08	STRC 09	35.56	8818.70	8817.31	3.9000	12.000	0.0150	1.97	6.10	0.32	6.92	0.39	0.39	0.00	Calculated
10	PIPE 10	Pipe	STRC 09	OUTFALL	27.01	8817.31	8812.03	19.5500	15.000	0.0120	1.97	30.94	0.06	14.06	0.21	0.17	0.00	Calculated

Subbasin Hydrology

Subbasin : POND_18_15_DRAIN

Input Data

Area (ac) 4.25
Weighted Curve Number 97.29
Rain Gage ID .... RAIN_GAGE

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	3.75	-	100.00
Fallow, bare soil	0.50	A	77.00
Composite Area & Weighted CN	4.25		97.29

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

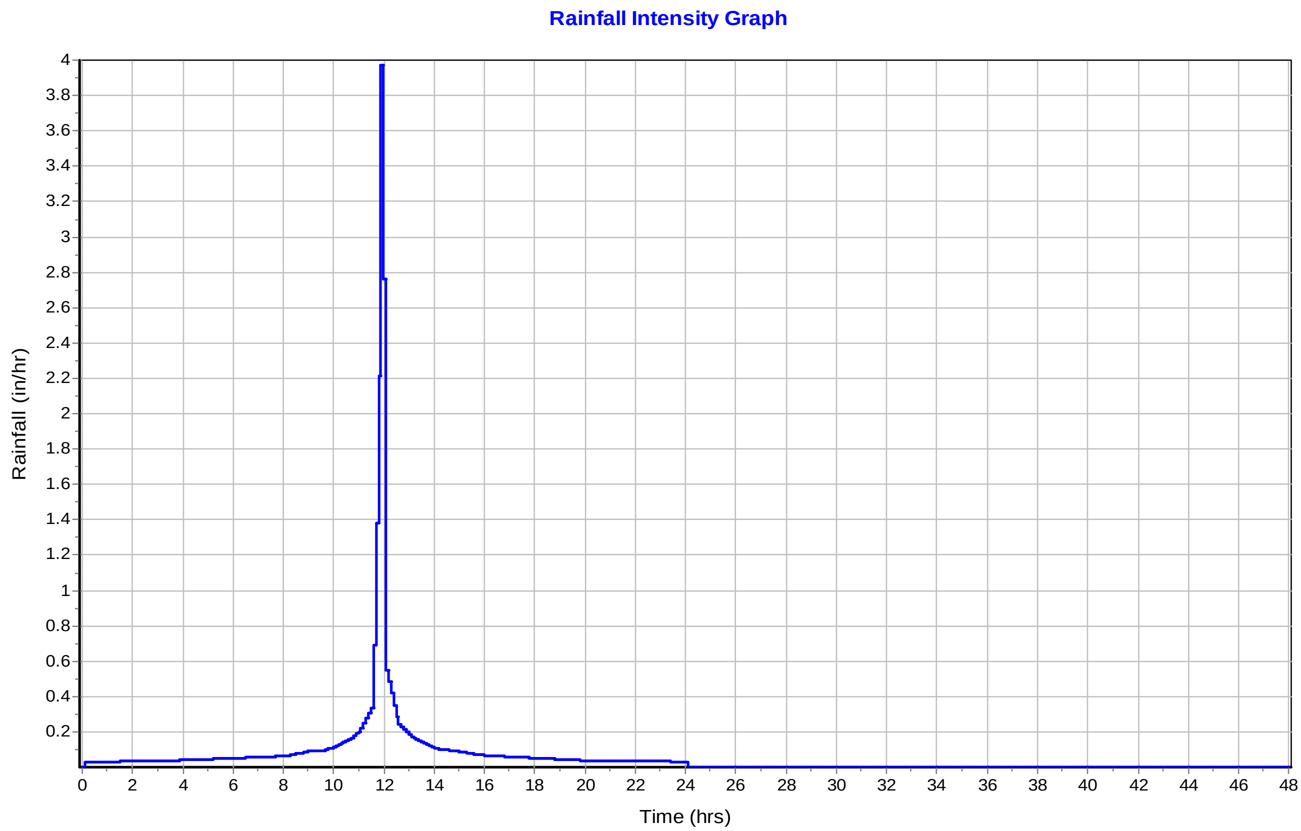
Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

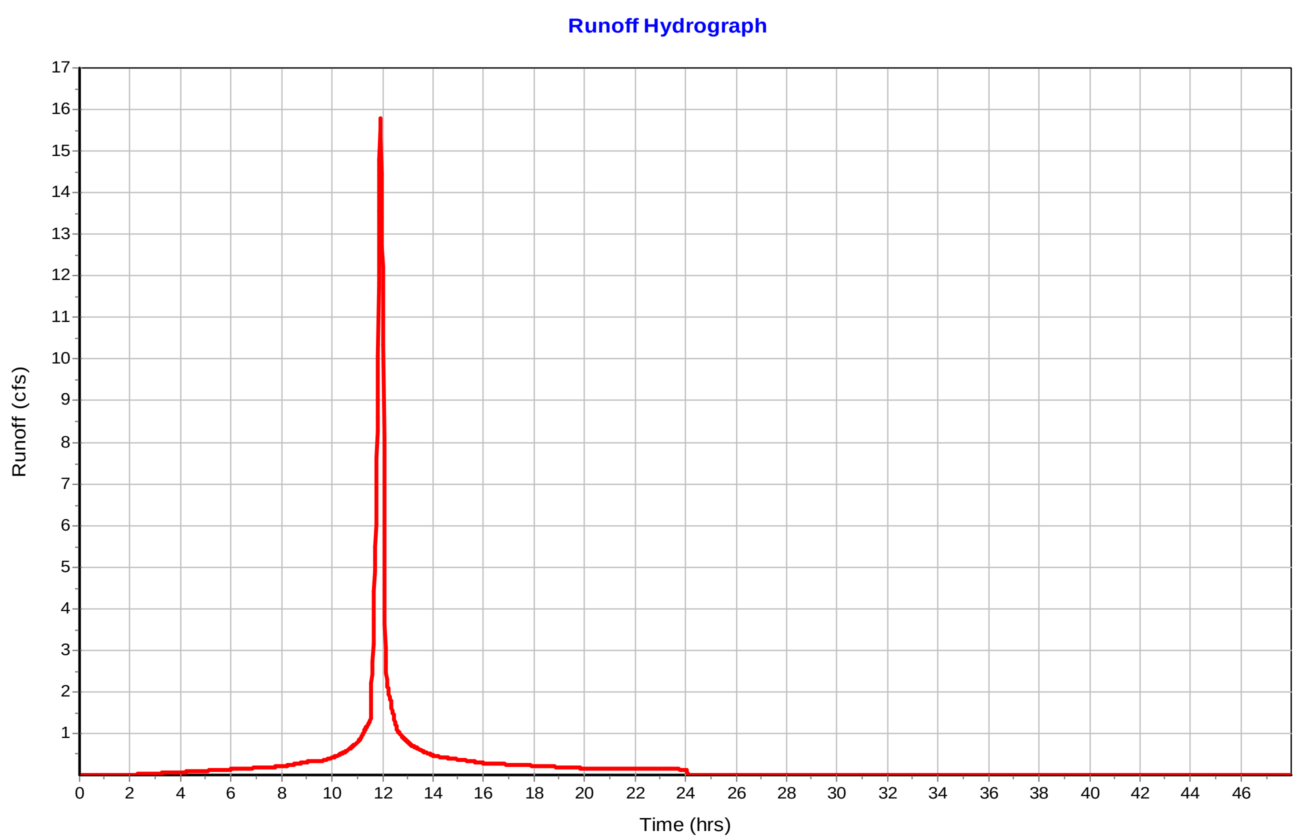
User-Defined TOC override (minutes): .1

Subbasin Runoff Results

Total Rainfall (in) 2.90
Total Runoff (in) 2.59
Peak Runoff (cfs) 15.80
Weighted Curve Number 97.29
Time of Concentration (days hh:mm:ss) 0 00:00:06

Subbasin : POND_18_15_DRAIN





Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft^2)	Minimum Pipe Cover (in)
1	STRC 01	8823.11	8824.19	1.08	8823.11	0.00	8824.19	0.00	0.00	0.00
2	STRC 02	8822.73	8823.80	1.08	8822.73	0.00	8823.80	0.00	0.00	0.00
3	STRC 03	8822.35	8823.43	1.08	8822.35	0.00	8823.43	0.00	0.00	0.00
4	STRC 04	8821.39	8822.47	1.08	8821.39	0.00	8822.47	0.00	0.00	0.00
5	STRC 05	8821.10	8822.17	1.08	8821.10	0.00	8822.17	0.00	0.00	0.00
6	STRC 06	8820.38	8821.46	1.08	8820.38	0.00	8821.46	0.00	0.00	0.00
7	STRC 07	8819.31	8820.38	1.08	8819.31	0.00	8820.38	0.00	0.00	0.00
8	STRC 08	8818.70	8819.77	1.08	8818.70	0.00	8819.77	0.00	0.00	0.00
9	STRC 09	8817.31	8818.99	1.68	8817.31	0.00	8818.99	0.00	0.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	STRC 01	1.97	0.00	8823.76	0.65	0.00	0.43	8823.71	0.60	0 11:55	0 00:00	0.00	0.00
2	STRC 02	1.97	0.00	8823.44	0.71	0.00	0.36	8823.37	0.64	0 11:55	0 00:00	0.00	0.00
3	STRC 03	1.97	0.00	8823.07	0.72	0.00	0.36	8823.00	0.65	0 11:55	0 00:00	0.00	0.00
4	STRC 04	1.97	0.00	8822.07	0.68	0.00	0.40	8822.01	0.62	0 11:56	0 00:00	0.00	0.00
5	STRC 05	1.97	0.00	8821.76	0.66	0.00	0.41	8821.70	0.60	0 11:56	0 00:00	0.00	0.00
6	STRC 06	1.97	0.00	8820.93	0.55	0.00	0.53	8820.88	0.50	0 11:57	0 00:00	0.00	0.00
7	STRC 07	1.97	0.00	8819.75	0.44	0.00	0.63	8819.72	0.41	0 11:57	0 00:00	0.00	0.00
8	STRC 08	1.97	0.00	8819.09	0.39	0.00	0.69	8819.06	0.36	0 11:57	0 00:00	0.00	0.00
9	STRC 09	1.97	0.00	8817.70	0.39	0.00	1.29	8817.67	0.36	0 11:57	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	PIPE 01	34.42	8823.19	3.50	8823.11	0.00	0.08	0.2200	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	2
2	PIPE 02	54.49	8823.11	0.00	8822.73	0.00	0.39	0.7100	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
3	PIPE 03	67.80	8822.73	0.00	8822.35	0.00	0.37	0.5500	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
4	PIPE 04	153.01	8822.35	0.00	8821.39	0.00	0.96	0.6300	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
5	PIPE 05	44.68	8821.39	0.00	8821.10	0.00	0.29	0.6600	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
6	PIPE 06	58.03	8821.10	0.00	8820.38	0.00	0.71	1.2300	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
7	PIPE 07	45.51	8820.38	0.00	8819.31	0.00	1.08	2.3700	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
8	PIPE 08	14.85	8819.31	0.00	8818.70	0.00	0.61	4.1000	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
9	PIPE 09	35.56	8818.70	0.00	8817.31	0.00	1.39	3.9000	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
10	PIPE 10	27.01	8817.31	0.00	8812.03	0.00	5.28	19.5500	CIRCULAR	15.000	15.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	PIPE 01	1.97	0 11:55	3.64	0.54	2.36	0.24	0.52	0.52	0.00		Calculated
2	PIPE 02	1.97	0 11:55	2.60	0.76	3.64	0.25	0.65	0.65	0.00		Calculated
3	PIPE 03	1.97	0 11:55	2.30	0.86	3.29	0.34	0.71	0.71	0.00		Calculated
4	PIPE 04	1.97	0 11:56	2.45	0.80	3.48	0.73	0.68	0.68	0.00		Calculated
5	PIPE 05	1.97	0 11:56	2.51	0.78	3.53	0.21	0.67	0.67	0.00		Calculated
6	PIPE 06	1.97	0 11:57	3.42	0.57	4.51	0.21	0.54	0.54	0.00		Calculated
7	PIPE 07	1.97	0 11:57	4.75	0.41	5.76	0.13	0.45	0.45	0.00		Calculated
8	PIPE 08	1.97	0 11:57	6.25	0.31	7.04	0.04	0.39	0.39	0.00		Calculated
9	PIPE 09	1.97	0 11:57	6.10	0.32	6.92	0.09	0.39	0.39	0.00		Calculated
10	PIPE 10	1.97	0 11:57	30.94	0.06	14.06	0.03	0.21	0.17	0.00		Calculated

Storage Nodes

Storage Node : POND_18

Input Data

Invert Elevation (ft)	8819.69
Max (Rim) Elevation (ft)	8826.00
Max (Rim) Offset (ft)	6.31
Initial Water Elevation (ft)	8823.69
Initial Water Depth (ft)	4.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Output Summary Results

Peak Inflow (cfs)	17.58
Peak Lateral Inflow (cfs)	17.58
Peak Outflow (cfs)	1.97
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	8824.37
Max HGL Depth Attained (ft)	4.68
Average HGL Elevation Attained (ft)	8824.22
Average HGL Depth Attained (ft)	4.53
Time of Max HGL Occurrence (days hh:mm)	1 00:06
Total Exfiltration Volume (1000-ft^3)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Solids Settling Detention Time Calculations

Pond 14 Solids removal via dredge required detention time (no flocculent) ACJ

Ferguson, R. I., and M. Church (2004), A Simple Universal Equation for Grain Settling Velocity, Journal of Sedimentary Research, 74(6) 933-937, doi: 10.1306/051204740933

Target Particle Size	0.0030	mm
	0.000003	Meters
Pumping Rate	900	gpm
	2.01	cfs
Op time	10	hr/day
	72321.43	cf/day w/ shutdown overnight
Pond 13 Size	100	ft width
	390	ft length
	2	ft depth
	78000	cf
	0.9	ac
Residence time	1.1	day
	26	hours
Settling Velocity	8.08E-06	m/s
	2.65E-05	ft/s
Settling time	75494	sec
	21	hours
	5	Residence minus Settling time (hrs) (must be zero or positive)

Assumptions

Uniformly distributed flow in detention pond

0.006 mm = 70% removal (based on Pond 15 solids gradation)

0.003 mm = 80% removal

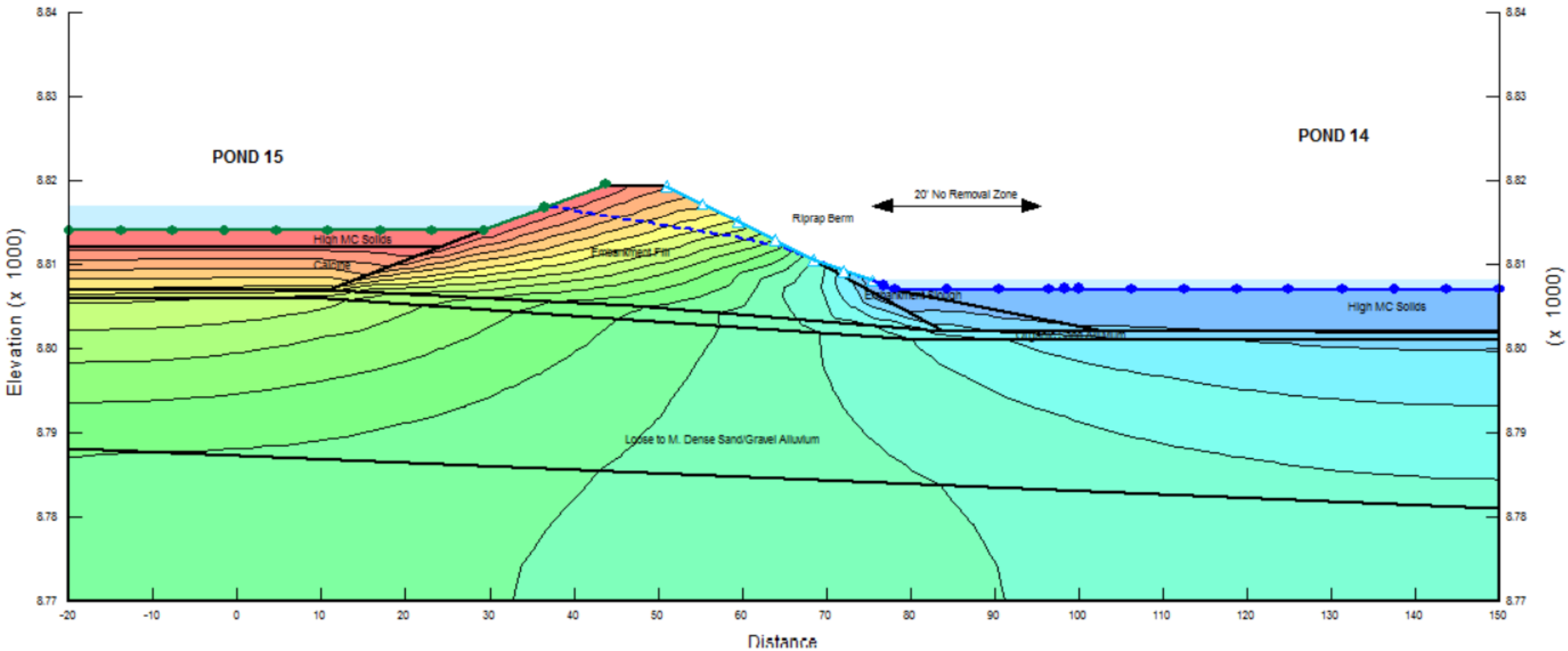
Conservatively does not account for increased settling due to Pond 13 seepage, which increases residence time

SLOPE/W Stability Analysis Results

RICO Pond 14 Removal Stability
Steady Seepage West Side Existing
Steady-State

File Name: Ponds 14 & 15 Dike.gsz
Date: 7/10/2014

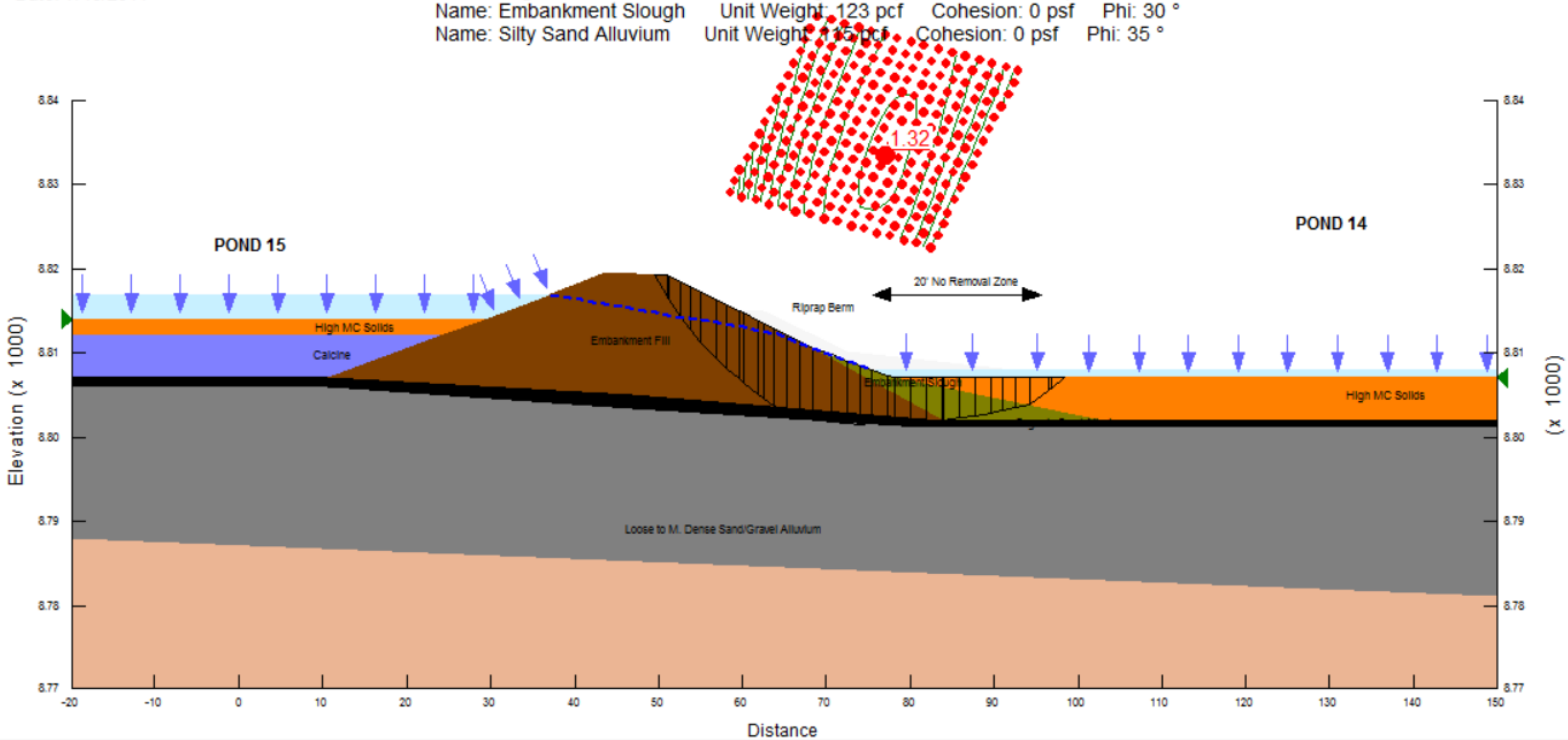
Name: Embankment Fill K-Sat: 9.84e-007 ft/sec K-Ratio: 0.1 K-Direction: 0 °
Name: Loose to M. Dense Sand/Gravel Alluvium K-Sat: 1.64e-005 ft/sec K-Ratio: 0.1 K-Direction: 0 °
Name: High MC Solids K-Sat: 8.2e-006 ft/sec K-Ratio: 0.2 K-Direction: 0 °
Name: Calcines (M. Dense to Loose) K-Sat: 3.28e-006 ft/sec K-Ratio: 0.2 K-Direction: 0 °
Name: Organic Sand Alluvium K-Sat: 3.28e-007 ft/sec K-Ratio: 1 K-Direction: 0 °
Name: Embankment Slough K-Sat: 6.56e-007 ft/sec K-Ratio: 1 K-Direction: 0 °
Name: Silty Sand Alluvium K-Sat: 3.28e-005 ft/sec K-Ratio: 0.1 K-Direction: 0 °



RICO Pond 14 Removal Stability
Stability West Side Existing
Morgenstern-Price

File Name: Ponds 14 & 15 Dike.gsz
Date: 7/10/2014

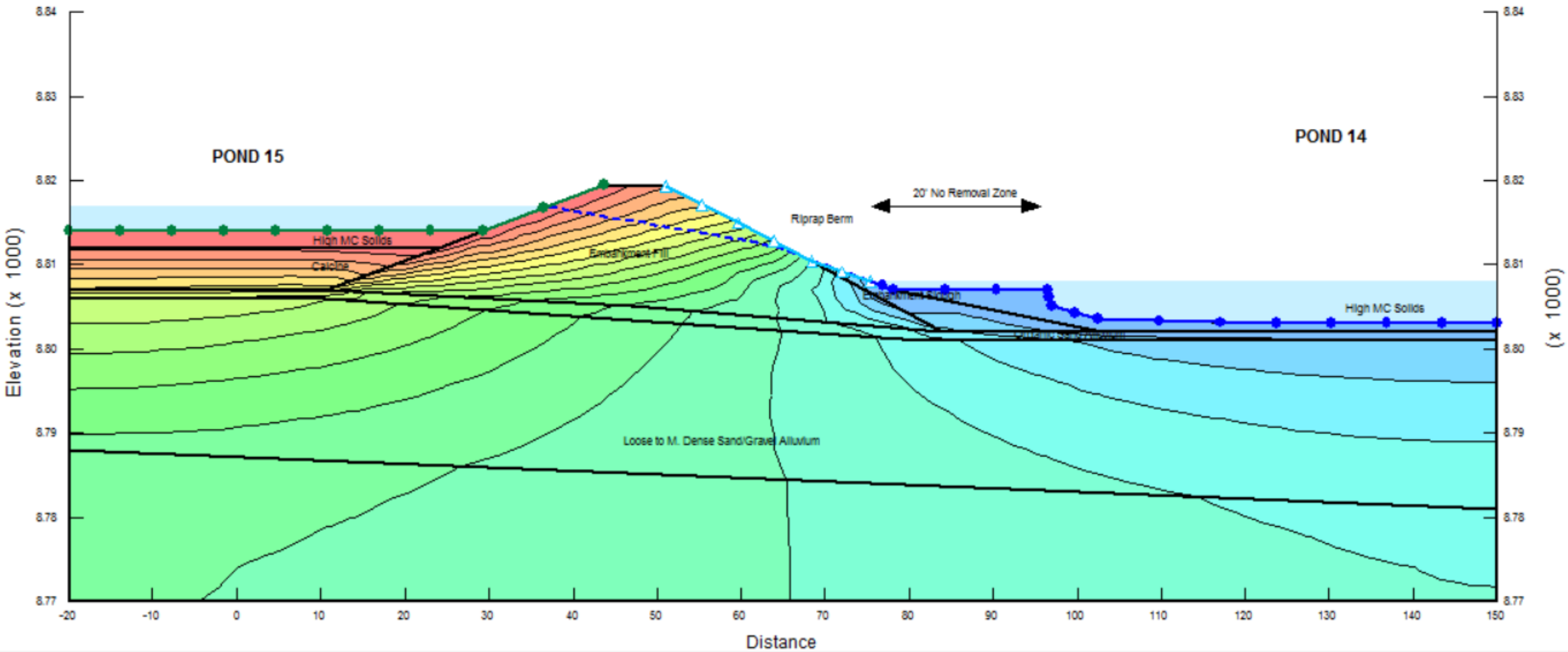
Name: Embankment Fill Unit Weight: 123 pcf Cohesion: 50 psf Phi: 35 °
Name: Loose to M. Dense Sand/Gravel Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 35 °
Name: High MC Solids Unit Weight: 70 pcf Cohesion: 50 psf Phi: 0 °
Name: Calcines (M. Dense to Loose) Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: Organic Sand Alluvium Unit Weight: 110 pcf Cohesion: 0 psf Phi: 30 °
Name: Embankment Slough Unit Weight: 123 pcf Cohesion: 0 psf Phi: 30 °
Name: Silty Sand Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 35 °



RICO Pond 14 Removal Stability
Steady Seepage West Side Post Removal
Steady-State

File Name: Ponds 14 & 15 Dike.gsz
Date: 7/10/2014

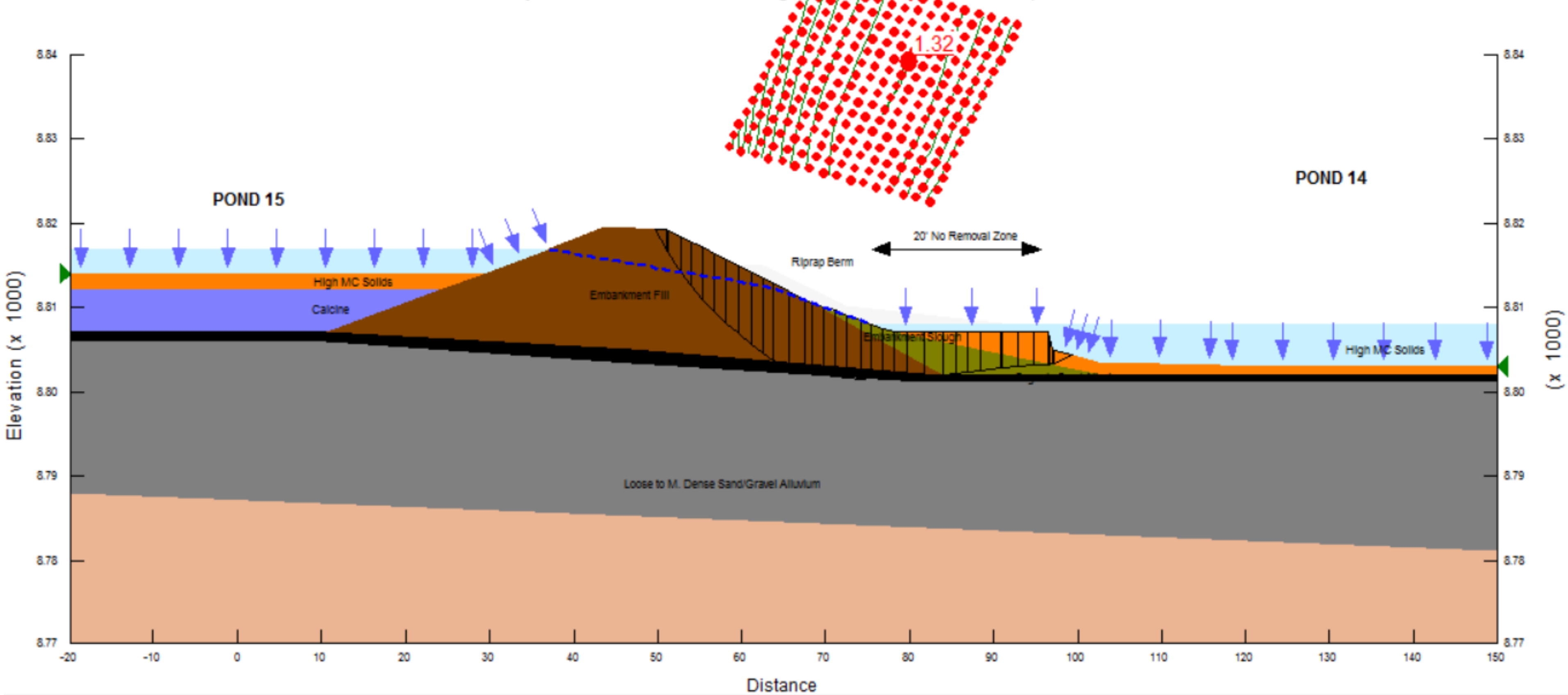
Name: Embankment Fill K-Sat: 9.84e-007 ft/sec K-Ratio: 0.1 K-Direction: 0 °
Name: Loose to M. Dense Sand/Gravel Alluvium K-Sat: 1.64e-005 ft/sec K-Ratio: 0.1 K-Direction: 0 °
Name: High MC Solids K-Sat: 8.2e-006 ft/sec K-Ratio: 0.2 K-Direction: 0 °
Name: Calcines (M. Dense to Loose) K-Sat: 3.28e-006 ft/sec K-Ratio: 0.2 K-Direction: 0 °
Name: Organic Sand Alluvium K-Sat: 3.28e-007 ft/sec K-Ratio: 1 K-Direction: 0 °
Name: Embankment Slough K-Sat: 6.56e-007 ft/sec K-Ratio: 1 K-Direction: 0 °
Name: Silty Sand Alluvium K-Sat: 3.28e-005 ft/sec K-Ratio: 0.1 K-Direction: 0 °



RICO Pond 14 Removal Stability
Stability West Side Post Removal
Morgenstern-Price

File Name: Ponds 14 & 15 Dike.gsz
Date: 7/10/2014

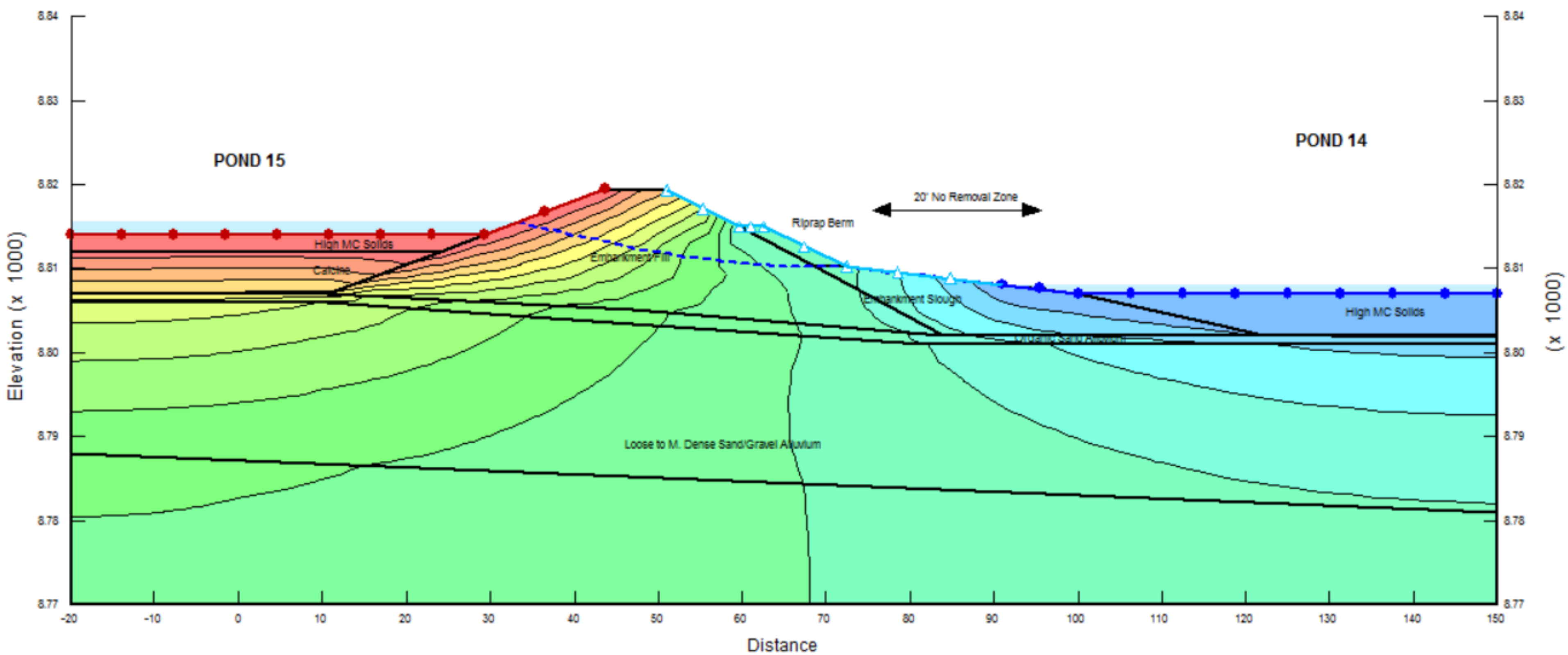
Name: Embankment Fill   Unit Weight: 123 pcf   Cohesion: 50 psf   Phi: 35 °
Name: Loose to M. Dense Sand/Gravel Alluvium   Unit Weight: 115 pcf   Cohesion: 0 psf   Phi: 35 °
Name: High MC Solids   Unit Weight: 70 pcf   Cohesion: 50 psf   Phi: 0 °
Name: Calcines (M. Dense to Loose)   Unit Weight: 115 pcf   Cohesion: 0 psf   Phi: 30 °
Name: Organic Sand Alluvium   Unit Weight: 110 pcf   Cohesion: 0 psf   Phi: 30 °
Name: Embankment Slough   Unit Weight: 123 pcf   Cohesion: 0 psf   Phi: 30 °
Name: Silty Sand Alluvium   Unit Weight: 115 pcf   Cohesion: 0 psf   Phi: 35 °



RICO Pond 14 Removal Stability
Steady Seepage East Side During Outlet Construction
Steady-State

File Name: Ponds 14 & 15 Dike.gsz
Date: 7/10/2014

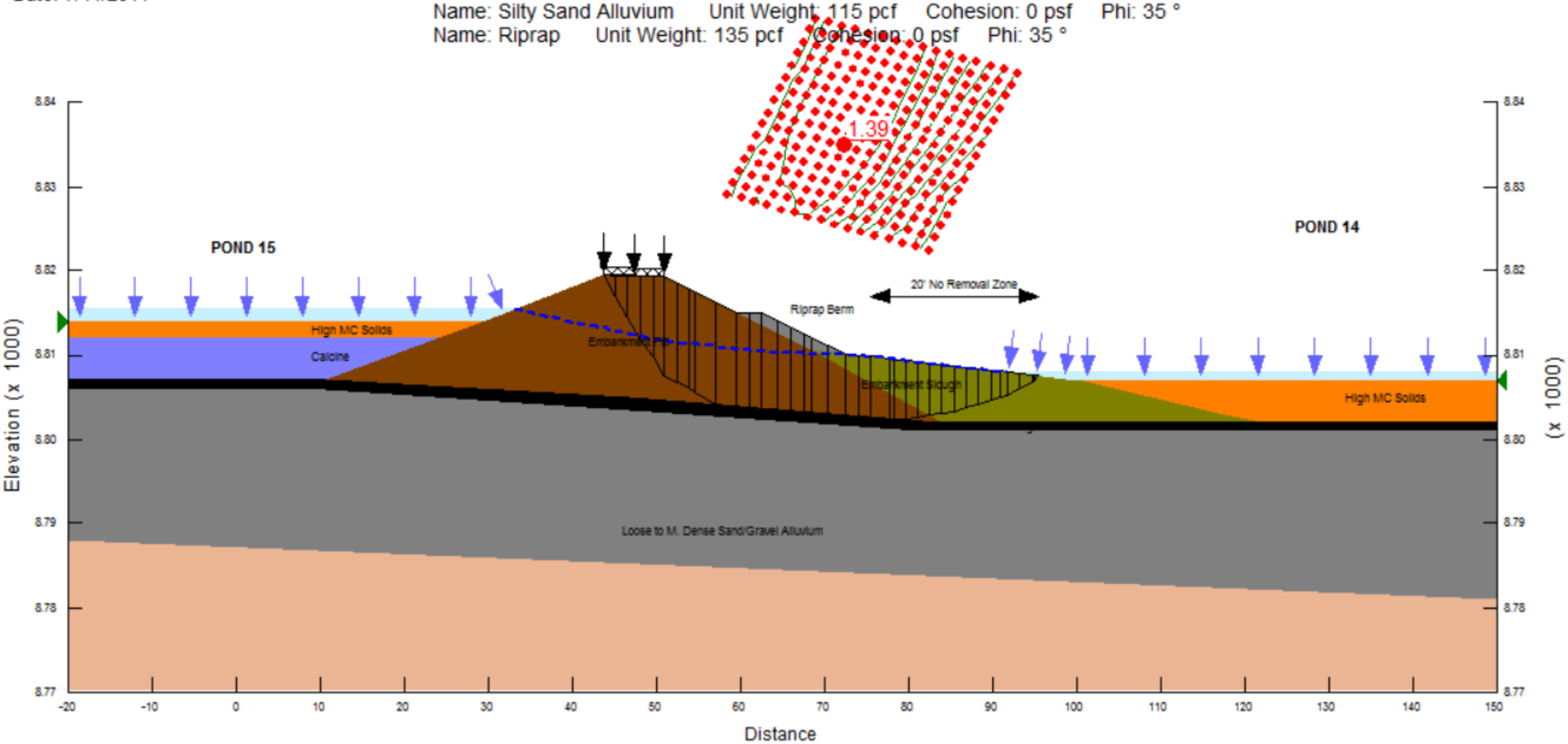
Name: Embankment Fill K-Sat: 9.84e-007 ft/sec K-Ratio: 0.1 K-Direction: 0 °
Name: Loose to M. Dense Sand/Gravel Alluvium K-Sat: 1.64e-005 ft/sec K-Ratio: 0.1 K-Direction: 0 °
Name: High MC Solids K-Sat: 8.2e-006 ft/sec K-Ratio: 0.2 K-Direction: 0 °
Name: Calcines (M. Dense to Loose) K-Sat: 3.28e-006 ft/sec K-Ratio: 0.2 K-Direction: 0 °
Name: Organic Sand Alluvium K-Sat: 3.28e-007 ft/sec K-Ratio: 1 K-Direction: 0 °
Name: Embankment Slough K-Sat: 6.56e-007 ft/sec K-Ratio: 1 K-Direction: 0 °
Name: Silty Sand Alluvium K-Sat: 3.28e-005 ft/sec K-Ratio: 0.1 K-Direction: 0 °
Name: Riprap K-Sat: 1 ft/sec K-Ratio: 1 K-Direction: 0 °



RICO Pond 14 Removal Stability
Downstream Stability East Side Excavator
Morgenstern-Price

File Name: Ponds 14 & 15 Dike.gsz
Date: 7/11/2014

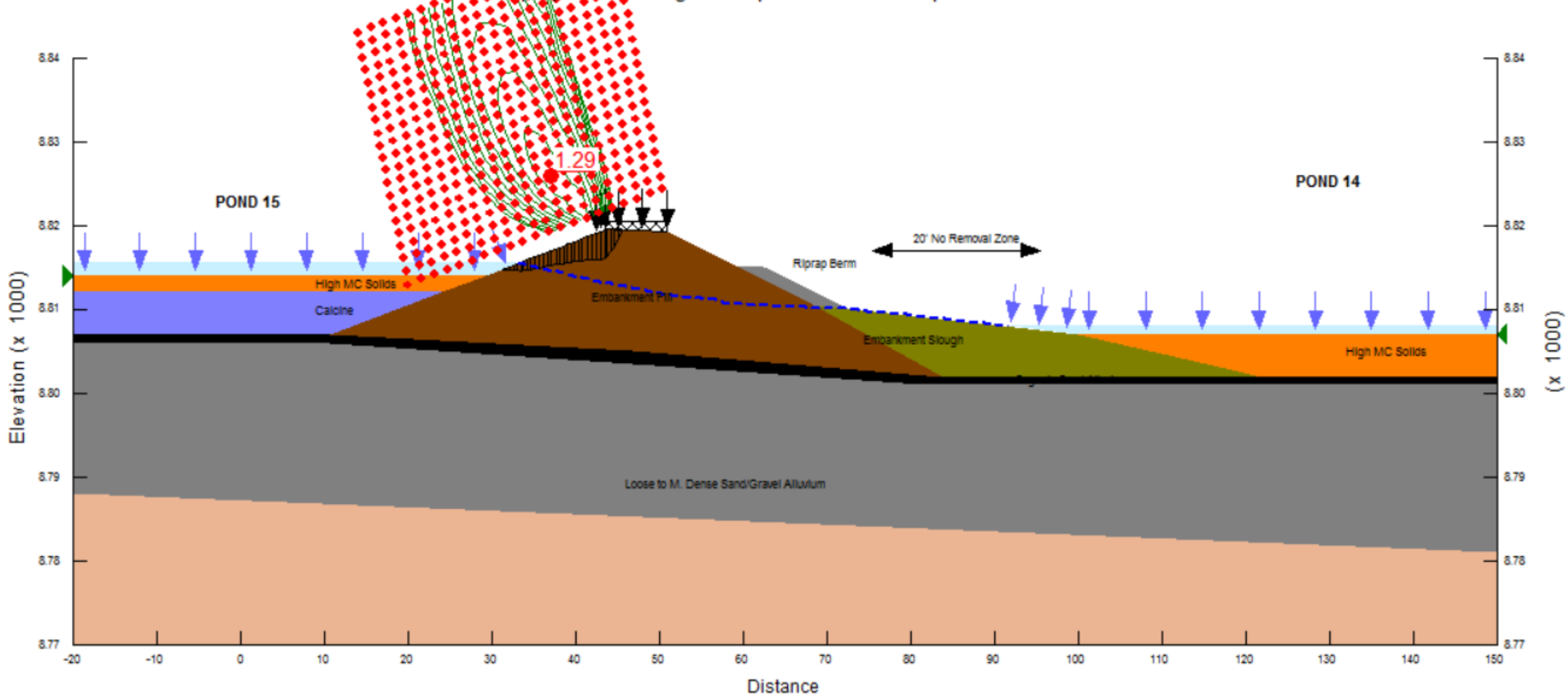
Name: Embankment Fill Unit Weight: 123 pcf Cohesion: 50 psf Phi: 35 °
Name: Loose to M. Dense Sand/Gravel Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 35 °
Name: High MC Solids Unit Weight: 70 pcf Cohesion: 50 psf Phi: 0 °
Name: Calcines (M. Dense to Loose) Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: Organic Sand Alluvium Unit Weight: 110 pcf Cohesion: 0 psf Phi: 30 °
Name: Embankment Slough Unit Weight: 123 pcf Cohesion: 0 psf Phi: 30 °
Name: Silty Sand Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 35 °
Name: Riprap Unit Weight: 135 pcf Cohesion: 0 psf Phi: 35 °



RICO Pond 14 Removal Stability
Upstream Stability East Side Excavator
Morgenstern-Price

File Name: Ponds 14 & 15 Dike.gsz
Date: 7/11/2014

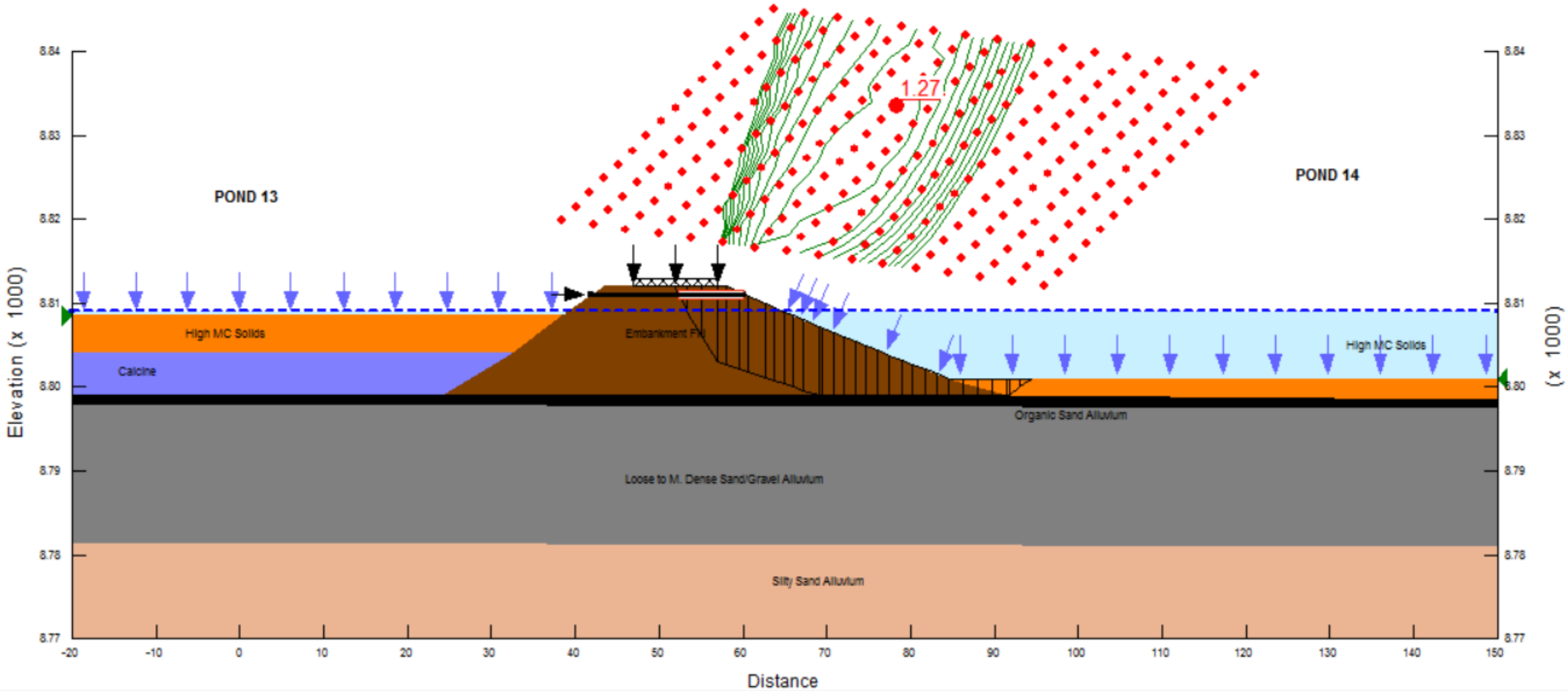
Name: Embankment Fill   Unit Weight: 123 pcf   Cohesion: 50 psf   Phi: 35 °
Name: Loose to M. Dense Sand/Gravel Alluvium   Unit Weight: 115 pcf   Cohesion: 0 psf   Phi: 35 °
Name: High MC Solids   Unit Weight: 70 pcf   Cohesion: 50 psf   Phi: 0 °
Name: Calcines (M. Dense to Loose)   Unit Weight: 115 pcf   Cohesion: 0 psf   Phi: 30 °
Name: Organic Sand Alluvium   Unit Weight: 110 pcf   Cohesion: 0 psf   Phi: 30 °
Name: Embankment Slough   Unit Weight: 123 pcf   Cohesion: 0 psf   Phi: 30 °
Name: Silty Sand Alluvium   Unit Weight: 115 pcf   Cohesion: 0 psf   Phi: 35 °
Name: Riprap   Unit Weight: 135 pcf   Cohesion: 0 psf   Phi: 35 °

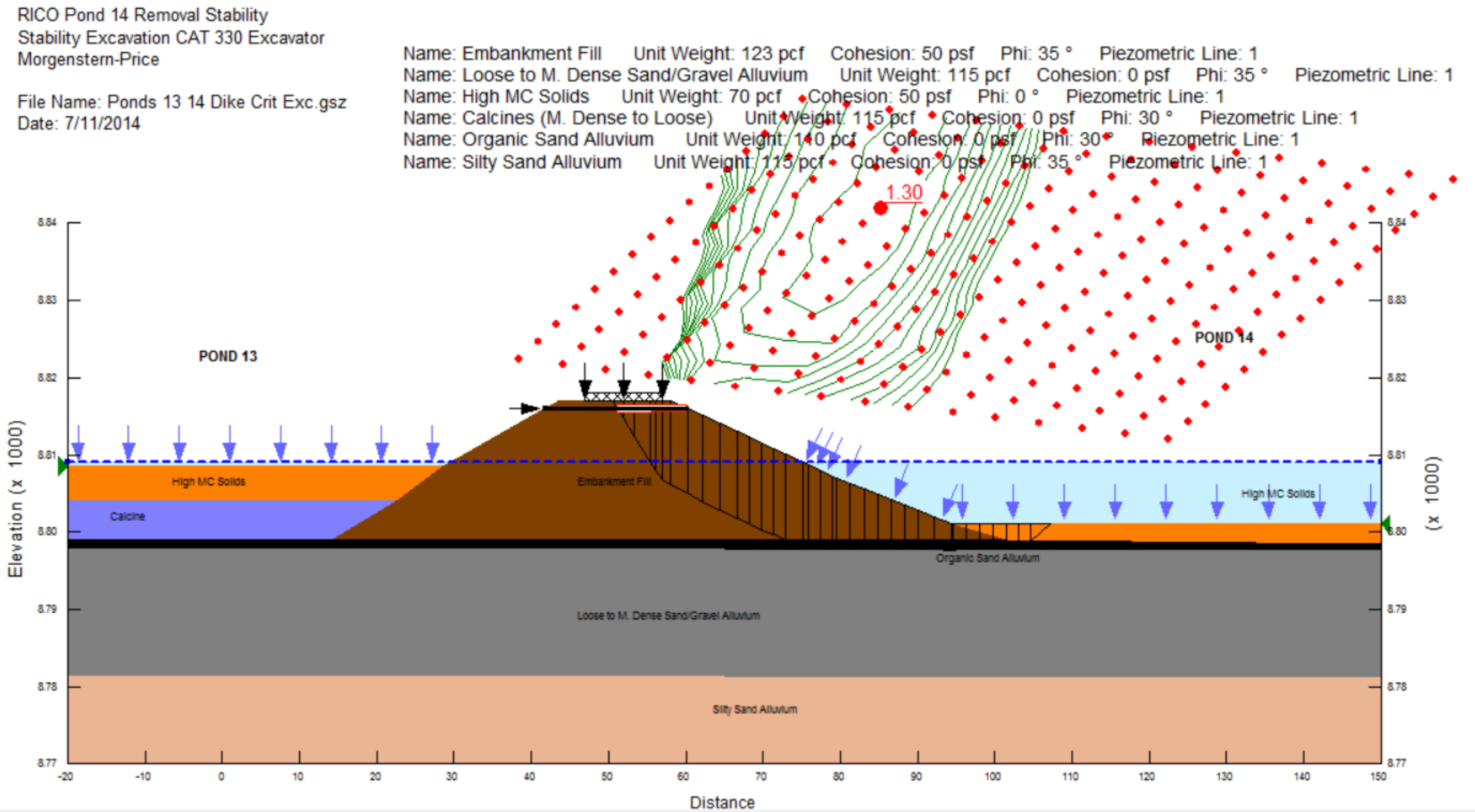


RICO Pond 14 Removal Stability
Stability Dredge Lift CAT 330 Excavator
Morgenstern-Price

File Name: Ponds 13 14 Dike.gsz
Date: 7/11/2014

Name: Embankment Fill   Unit Weight: 123 pcf   Cohesion: 50 psf   Phi: 35 °   Piezometric Line: 1
Name: Loose to M. Dense Sand/Gravel Alluvium   Unit Weight: 115 pcf   Cohesion: 0 psf   Phi: 35 °   Piezometric Line: 1
Name: High MC Solids   Unit Weight: 70 pcf   Cohesion: 50 psf   Phi: 0 °   Piezometric Line: 1
Name: Calcines (M. Dense to Loose)   Unit Weight: 115 pcf   Cohesion: 0 psf   Phi: 30 °   Piezometric Line: 1
Name: Organic Sand Alluvium   Unit Weight: 110 pcf   Cohesion: 0 psf   Phi: 30 °   Piezometric Line: 1
Name: Silty Sand Alluvium   Unit Weight: 115 pcf   Cohesion: 0 psf   Phi: 35 °   Piezometric Line: 1





RICO Pond 14 Removal Stability
Stability Excavation CAT 330 Excavator
Morgenstern-Price
File Name: Ponds 13 14 Dike Crit Exc.gsz
Date: 7/11/2014
Name: Embankment Fill Unit Weight: 123 pcf Cohesion: 50 psf Phi: 35 ° Piezometric Line: 1
Name: Loose to M. Dense Sand/Gravel Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 35 ° Piezometric Line: 1
Name: High MC Solids Unit Weight: 70 pcf Cohesion: 50 psf Phi: 0 ° Piezometric Line: 1
Name: Calcines (M. Dense to Loose) Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 1
Name: Organic Sand Alluvium Unit Weight: 140 pcf Cohesion: 0 psf Phi: 30 ° Piezometric Line: 1
Name: Silty Sand Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 35 ° Piezometric Line: 1
1.30
POND 13
POND 14
High MC Solids
Calcine
Embankment Fill
High MC Solids
Organic Sand Alluvium
Loose to M. Dense Sand/Gravel Alluvium
Silty Sand Alluvium
Elevation (x 1000)
(x 1000)
Distance

Construction Technical Specifications: Upgrade of Pond 15 Outlet

Rico-Argentine Site-OU-01
Upgrade of Pond 15 Outlet
Construction Technical Specifications
21 July 2014

Section 02300 - Earthwork

SECTION 02300

EARTHWORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes materials, testing, and earthwork for excavations and fill

1.02 EXISTING INSTRUMENTATION

A. Monitoring Wells. Monitoring wells at the site are shown on the Drawings and shall be protected by the contractor during construction.

1.03 REFERENCES

A. American Society for Testing and Materials International (ASTM):

1. ASTM D 422 - Standard Test Method for Particle-Size Analysis of Soils.
2. ASTM D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft2) (600 kN-m/m2).
3. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
4. ASTM D 1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft2) (2,700 kN-m/m2).
5. ASTM D 2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
6. ASTM D 2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
7. ASTM D 2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
8. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soil.
9. ASTM D 4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
10. ASTM D 4254 - Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
11. ASTM D 6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

12. ASTM D 7382 - Standard Test Methods for Determination of Dry Unit Weight and Water Content Range for Effective Compaction of Granular Soils Using a Vibratory Hammer.

1.04 TESTING

A. An Independent Testing Service will test for compaction at locations and times at the discretion of Field Manager/Engineer.

B. Contractor shall provide access to testing locations and cooperate with the Independent Testing Service during testing by temporarily shutting down construction operations in the vicinity of the testing if requested.

C. Contractor may perform testing at its discretion to control compaction; however, testing performed by the Independent Testing Service and results reviewed by Field Manager/Engineer shall govern.

D. Reference compaction testing (ASTM D1557, D4253, D4254 and/or D7382) other material quality testing shall be performed once per 2500 cy or material change and in-place density testing (ASTM D6938 or equivalent) shall be performed on subgrade and once every three (3) lifts placed or as directed by the Field Manager/Engineer.

1.05 DISPOSAL OF EXCESS AND UNSUITABLE MATERIALS

A. Excess excavated or unsuitable material not meeting the requirements of this Specification for use as fill that is generated on-site shall be disposed of on-site as directed by Field Manager/Engineer.

1.06 MATERIAL AVAILABILITY

A. Sufficient earthwork material to complete the Work is available onsite. Contractor shall obtain material from the Solids Repository excavation or from designated stockpile.

PART 2 - MATERIALS

2.01 TYPE A FILL

A. Type A shall be select materials from required excavations or imported fill classifying as GW or GC per ASTM D 2487 with maximum rock size of 1.5 inches and free of frozen materials, mine waste, contaminants, organics, trash, debris, and other deleterious substances.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment Load Limits and Restrictions:

1. Ground pressures shall not exceed 1400 psf for a full-size track hoe working parallel to the axis of the dike. Approved rigid (timber or other) mats must be used to distribute ground pressure. Mats shall be made accessible for inspection prior to use.

2. Only walk-behind or remote-control (unmanned) compactors will be permitted.

B. Pond 15 Elevation

1. Pond 15 shall be maintained offline at an elevation of 8814.5 or lower at all times during the Pond 15 Outlet upgrade earthwork.

C. Pond 18 Elevation

1. Pond 18 shall be maintained at an elevation of 8822 or lower at all times during the Pond 15 Outlet upgrade work.

2. Pond 18 shall be pumped down (via Bypass Pipeline to Pond 14) to 8820 or lower prior to overnight shutdown while the work is in progress.

D. Sequencing

1. Type A fill shall be pre-processed in sufficient quantities and ready to place prior to excavation.

2. Pipe assemblies should be fitted, assembled or reworked prior to excavation to the degree practical.

3. Diversion of flow to Pond 18 shall occur just before excavation, except as required by the needs of the Demonstration Wetlands (by Others).

4. Work shall be sequenced such that the excavation is open for the minimum time possible.

5. Work shall be sequenced to be completed during a normal workweek with no excavation open over a weekend.

3.02 EXCAVATION

A. Identify and clearly mark Monitoring Wells and existing utilities prior to commencing work and protect from damage.

3.03 PLACING AND COMPACTING

A. Fill shall be compacted in place in maximum 6-inch lifts as follows:

1. Fill material with greater than 12 percent passing the No. 200 sieve shall be compacted to at least 95 percent of the maximum dry density and within zero (0) to plus two (2) percent and minus three (3) percent of the optimum water content, when tested in accordance with ASTM D 1557.
2. Fill material with less than five (5) percent passing the No. 200 sieve shall be compacted to at least 75 percent of relative density when tested in accordance with ASTM D 4253 and D 4254 and with sufficient water to prevent bulking, or to 95 percent of the maximum density and within the range of water content for effective compaction as determined when tested in accordance with ASTM 7382, at the discretion of the Field Manager/Engineer.
3. Fill material with five (5) to 12 percent passing the No. 200 sieve shall be compacted to either 95 percent of maximum dry density when tested in accordance with ASTM D 1557, or 75 percent of relative density when tested in accordance with ASTM D 4253 and ASTM D 4254, or to 95 percent of the maximum density as determined when tested in accordance with ASTM D 7382, at the discretion of the Field Manager/Engineer; moisture content shall be within zero (0) to plus two (2) percent and minus three (3) percent of optimum water content when compaction is controlled per ASTM D 1557, sufficient to prevent bulking when compaction is controlled by ASTM D 4253 and ASTM D 4254, and within the range for effective compaction as determined when tested in accordance with ASTM 7382.

B. Contractor is otherwise responsible for selecting equipment and employing means and methods to achieve the compaction requirements in this section.

C. Materials not meeting the specified moisture content and/or percent compaction shall be reworked until acceptable results are obtained. Reworking may include removal, rehandling, reconditioning, rerolling, or combinations of these procedures.

END OF SECTION